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South Australia.

DEPARTMENT OF MINES.

MINING REVIEW

FOR THE

HALF-YEAR ENDED DECEMBER 31st, 1919.

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No. 31.

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Compiled by LIONEL C. E. GEE, S.M., Chief Registrar and Recorder, Department of Mines

ISSUED UNDER THE AUTHORITY OF THE

HONORABLE W. H. HARVEY, M.L.C.,

Minister of Mines.

DEPARTMENT OF GEOLOGICAL SCIENCES
UNIVERSITY OF TORONTO

Adelaide:
R. E. E. ROGERS, GOVERNMENT PRINTER, NORTH TERRACE.

1920.

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MINER'S RIGHTS AND PRIVILEGES THEREUNDER.

A miner's right is obtainable at the Department of Mines, Adelaide, also at the issuing stations in the various mining districts, at a cost of 5s.; it is in force for one year from the date of issue, and may be renewed at any time during its currency for another term of one year on payment of 5s. The holder is authorised to prospect on any mineral lands for any metal, mineral, coal, or oil, and to peg out (of the prescribed shape and dimensions) gold, precious stones, mineral, coal, and oil claims, and also obtain leases, as detailed below.

AREAS AND WORKING CONDITIONS.

GOLD LEASES—Maximum area, 20 acres; working conditions, one man to every five acres.

MINERAL LEASES—40 acres; one man to every 10 acres.

MISCELLANEOUS LEASES—

Salt	640 acres;	special conditions.
Gypsum	640 "	"
Mining Works	10 "	one man.
COAL OR OIL LEASES	640 "	one man to every 40 acres.
GOLD DREDGING LEASES	200 "	special conditions.
MINERAL CLAIMS	40 "	
GOLD CLAIMS	30ft. x 30ft., alluvial; 100ft. x 600ft., reef.	
PRECIOUS STONES CLAIMS	150ft. x 150ft.	

Gold and Precious Stones claims must be constantly worked—one man for each claim—mineral claimholders must employ two men for each claim. Coal or oil claims, eight men. Amalgamation of gold (reef), mineral, coal, or oil claims reduces the labor conditions by one-half until payable results have been obtained.

Gold, mineral, coal, and oil leases are granted for a term not exceeding 21 years—the two former at a rental of 1s. per acre per annum and a royalty of 6d. in the pound on net profits, the latter at a rental of 6d. per acre per annum until coal or oil is found in payable quantities, when 1s. per acre is payable and a royalty of 6d. in the pound on the net profits.

The Minister may permit, for the concentration of labor, of the amalgamation of not more than four adjoining gold or mineral leases.

Any number of gold (reef), mineral, coal, or oil leases may be held by one person.

Licences to search for twelve months for precious stones, mineral phosphates, oil, rare metals, minerals, and earths are issued on specific mineral lands, not exceeding five square miles in area for one person, a fee of 20s. being charged for each square mile or portion thereof. The licences for mineral phosphates, oil and rare metals, minerals and earths give a preferential right to a lease over a portion of the area, as prescribed, and in case of a licence to search for precious stones, to a precious stones claim not exceeding the prescribed area.

MINING ON PRIVATE PROPERTY.

The Mining on Private Property Act of 1909 and the amending Act of 1916 apply only to land, the metals, minerals, precious stones, metalliferous ores, coal, shale, oil, salt, or gypsum on or under which are alienated from the Crown in fee simple.

Prior to 1886 all metals, minerals, &c., were sold with the land (these lands are defined as " Private land " in the Acts), but since 1886 gold, and since 1888 all the metals and minerals in lands sold by the Government are reserved to the Crown and can be dealt with under the Mining Act of 1893.

All arrangements for entry and for mining on private land can be made, if feasible, between the prospector and the owner of the freehold without reference to the Mining on Private Property Acts, *save that a copy of any agreement made must be forwarded without delay to the Mines Office, and six monthly returns giving full details of the mining operations must be furnished.*

The procedure necessary under the Acts is now according to the following summary :—

(1) The prospector will obtain a miner's right.

(2) He will apply for a written authority to enter and peg out from the Minister, or a warden, or mining registrar ; to obtain which it is necessary for him to lodge at the Mines Office a statutory declaration made before a Justice to the effect that there are reasonable grounds, which must be shortly stated, for supposing the land to be mineral bearing ; also a plan showing the land referred to, and a deposit of a sum of money as security against any possible damage done by him during the fourteen (14) days allowed for preliminary prospecting. In connection with the deposit required, the amount should, if possible, be arranged between the applicant and the owner of the land ; but if at the expiration of seven (7) days after an application in this behalf has been made by the applicant to the owner, the amount cannot be agreed upon, the amount of the deposit will be assessed by the department.

(3) On receiving the authority, before actually entering upon the private land, three (3) clear days' notice in writing must be given to the owner and occupier.

(4) The authority entitles the prospector to prospect between the hours of 6 a.m. and 6 p.m. for a period not exceeding fourteen (14) days on an area not exceeding one square mile ; also to make trenches and sink holes, provided that the area of the surface broken by such operations does not exceed 100 square feet. The prospector may also remove samples not exceeding 28lbs. in weight.

(5) If he is satisfied he may peg out the area which he desires to have included in a claim or lease.

(6) The prospector then endeavors to make a private arrangement with the owner of the property for the working of the mineral deposit.

(7) If, after the expiry of one month, he fails to arrive at a satisfactory agreement with the owner, he can apply for a compulsory mining lease.

(8) On the granting of such lease the work of mining or actually raising ore for sale can be commenced.

The right formerly possessed by the owner of the land to work the property himself within a period of two months by complying with the necessary working conditions no longer exists.

NOTES FOR OPAL MINERS.

Every miner must have a miner's right. The fee is 5s. per annum, and they are obtainable at the Adelaide Mines Office, Tarcoola, Port Augusta, Beltana, Hergott (Marree), and Oodnadatta Police Stations, and from Mr. J. W. Duck, Leigh Creek (Copley).

A miner's right may be issued to any " person "—that is, any individual above the age of 16 years. This right forms the basis of all operations under the Mining Acts. Without it a person has no protection, cannot legally prospect or mine, or peg out a claim, and, moreover, is liable to a penalty of £1 per day for unlawfully prospecting and mining.

The holder is authorised to prospect for any metal, mineral, precious stones, coal, or oil, the property of the Crown, with the right of possession when found. It is the authority for pegging out a claim and also to occupy for residence a quarter of an acre of land, from which the holder has the right to remove any buildings erected by him, and he may cut and use timber from Crown lands for his own mining and domestic purposes. Each claim must be represented by a miner's right, and it must be noted that no person can hold more than *one* precious stones claim at the same time.

The area allowed for a precious stones claim is 150ft. by 150ft., and is to be pegged out in the following way :—Four pegs are to be securely placed in the ground to mark the four corners. Each peg must be not less than 3in. thick and project not less than 3ft. above the surface of the ground, and have clearly marked on it the number of the miner's right and the date of pegging. From each peg two trenches must be cut in the ground not less than 3ft. long, 1ft. wide, and 6in. deep, pointing in the directions of the boundary lines of which the peg forms the corner. In rocky ground stone direction piles may be made instead of the trenches. All these marks must be maintained in position while the claim is held, or the claim will be liable to forfeiture. When pegging out ground adjoining another claim a wall 3ft. wide must be left between the claims. The working conditions are one man to be kept constantly employed for each precious stones claim. Constantly employed means eight hours for five working days of the week and four hours for Saturday. Claims can be held for 30 days without registration, and under exceptional circumstances this period may be extended for a further 14 days. The registration must be made at the Adelaide Office, and the form of application is simple and readily obtainable. It must show name and address of applicant, number of miner's right, nature of claim, locality, and sketch showing position. The miner's right must be attached to the application and a fee of 2s. 6d. paid. The certificate of registration is then issued from the Adelaide Office, and the miner's right returned to the applicant with the registered number marked thereon. Care must be taken that the miner's right, by virtue of which the claim is held, is kept valid by renewal at the proper time and not allowed to lapse, otherwise the certificate will become void and the title to the ground lapses.

Every holder of a claim is protected—

(*a*) While he is incapacitated from work by illness ;
(*b*) Absent on urgent business ;
(*c*) In attendance at a court of law ;
(*d*) During the continuance of floods or droughts ;
(*e*) While he is engaged upon work in public or national interest ;
(*f*) During public holidays ; and
(*g*) During 14 days commencing on the 22nd December, and in mines that are over one day's railway journey from Adelaide the Christmas exemption may extend for one month from December 15th, under the Minister's authority.

The onus of proof of good cause for absence lies on the claimholder. Notices should be placed on the claim and also forwarded to the Mines Office, Adelaide.

PREFACE.

CONTAINED in this "Mining Review" are the statistics of production for the whole of 1919; and it will be seen that, when the dislocation of marine transport and the attendant shortage of fuel have been taken into consideration, the results are satisfactory. The diminution in the output of copper has, of course, seriously affected the total value of the State's production for the year, towards which iron ore for the first time makes the largest contribution. The value of the iron ore produced would have been larger, but for the same interfering causes that affected the copper production.

Of the non-metallic minerals the production has been, on the whole, maintained, and the value of the precious opal raised has increased materially.

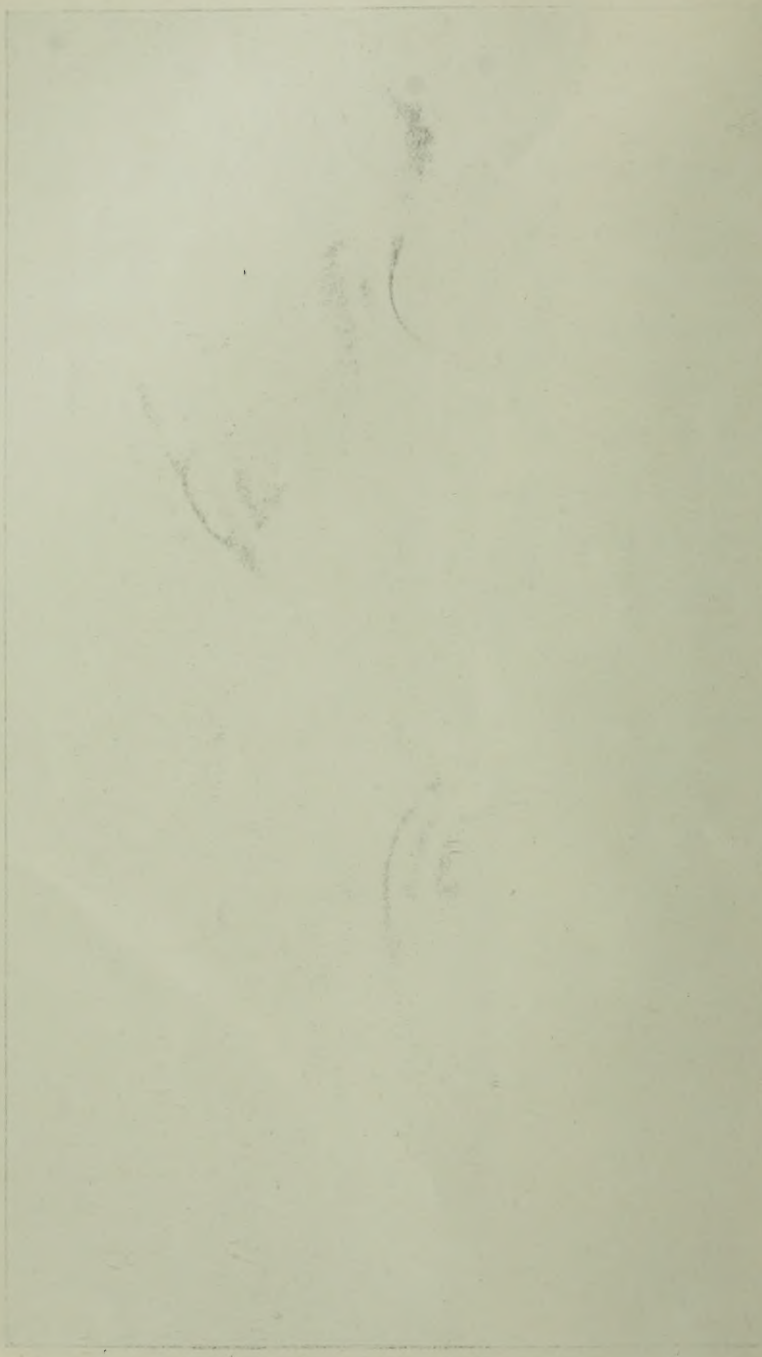
The Chief Registrar and Recorder has visited Iron Knob and Hummock Hill, and prepared an account of the welfare work carried out by the Broken Hill Proprietary Company in the interests of its employees. This report supplements those already published with regard to the similar work that has been carried out at Port Pirie, Wallaroo, and Moonta.

L. KEITH WARD,
Director of Mines.

March 27th, 1920.

Hummock Hill (Whyalla) from the Westward.

Face p. 6



INDEX.

DECENNIAL RETURN SHOWING, SO FAR AS CAN BE ASCERTAINED, PRODUCED IN

	1910.		1911.		1912.		1913.		1914.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	ozs.	£	ozs.	£	ozs.	£	ozs.	£	ozs.	£
Gold	6,603	28,000	3,537	15,000	6.592	28,000	6,556	27,800	6,258	26,581
Silver	6,250	625	1,400	140	2,700	326	2,650	300	3,006	314
Silver Lead Ore	Tons 25	22	—	—	—	—	Tons 153	1,100	Tons 18	215
Copper	cwts. 102,040	306,120	cwts. 118,440	332,500	cwts. 125,900	461,500	cwts. 143,222	488,986	cwts. 137,614	417,487
Lead	400	260	—	—	—	—	—	—	—	—
Ironstone	Tons 46,200	21,945	Tons 42,300	26,400	Tons 42,200	26,375	Tons 60,658	37,911	Tons 42,622	37,137
Manganese Ore	—	—	—	—	—	—	—	—	—	—
Molybdenite	—	—	—	—	—	—	—	—	—	—
Wolfram Ore	—	—	cwts. 40	154	cwts. 5	20	cwts. 2½	10	cwts. 6	24
Radium and Radio Active Material (Uranium Ore)	—	—	—	—	—	—	—	3,620	—	5,215
Asbestos	—	—	—	—	—	—	—	—	—	—
Alunite	—	—	—	—	—	—	—	—	Tons 20	40
Barytes	60	180	—	—	—	—	Tons 103	320	560	1,680
Bluestone	299	5,980	Tons 181	4,163	Tons 102	2,550	13	325	—	—
Chalk (Talc)	40	100	100	200	120	600	50	250	—	—
Fireclay and Pipeclay	922	188	1,463	169	200	150	320	240	1,223	917
Gypsum	15,800	9,000	9,700	7,275	12,000	9,00	7,150	5,362	16,276	12,207
Kaolin	—	—	—	—	—	—	—	—	10,239	16,382
Limestone	18,600	3,720	28,700	7,175	50,600	12,500	44.300	11,075	54,054	16,892
Magnesite	—	—	—	—	—	—	—	—	—	—
Mica	—	—	—	—	—	—	—	—	—	—
Ochre (crude)	180	746	105	105	300	300	250	250	84	84
Opal	—	—	—	—	—	—	—	—	—	—
Pebbles, Flint	—	—	458	856	120	420	514	1,799	270	829
Phosphate Rock	5,200	5,200	5,800	5,800	6,100	6,100	5,950	6,545	6,083	6,691
Pyrites	2,920	3,270	2,496	2,560	—	—	—	—	—	—
Salt (crude)	54,000	27,000	65,000	40,600	64,300	40,187	65,000	48,750	65,000	48,750
Sulphuric Acid	4,758	3,370	4,626	6,940	5,095	7,642	5,602	7,983	5,940	8,910
Soapstone	90	116	—	—	—	—	—	—	—	—
£	—	415,842	—	450,037	—	595,670	—	642,626	—	600,355

OUTPUT AND VALUE OF THE VARIOUS METALS AND MINERALS SOUTH AUSTRALIA.

1915.		1916.		1917.		1918.		1919.		1910-1919.	
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Total Output.	Total Value.
ozs.	£	ozs.	£	ozs.	£	ozs.	£	ozs.	£	ozs.	£
6,081	25,930	7,769	33,000	7,145	30,334	6,189	26,252	3,224	13,696	59,954	254,493
2,462	277	3,427	514	1,825	333	1,608	331	561	180	25,889	3,340
Tons 59	625	Tons 243	4,659	Tons 622	12,018	Tons 503	10,161	Tons —	—	Tons 1,623	28,800
cwts. 154,506	561,247	cwts. 145,580	822,527	cwts. 144,262	902,495	cwts. 143,378	828,556	cwts. 50,335	228,930	cwts. 1,265,277	5,350,348
—	—	—	—	—	—	—	—	—	—	Tons 20	260
Tons 237,375	264,612	Tons 188,329	200,382	Tons 328,386	359.723	Tons 257.029	277,279	Tons 268,530	307,402	1,513.629	1,559,166
250	563	544	2,700	264	1,597	1,080	17,876	298	1,490	2,436	24,226
—	—	—	—	cwts. 18½	359	cwts. 4½	98	cwts. 3½	70	T. c. 1 6½	527
cwts. 5	35	cwts. 4	28	4	30	—	—	—	—	3 6½	301
—	—	—	—	—	—	—	686	—	—	—	9,521
7	5	Tons. 21	210	—	—	—	—	—	—	T. c. 21 7	215
—	—	134	670	Tons 29	145	—	—	Tons 60	246	Tons 243	1,101
Tons 290	1,320	456	2,052	790	2,370	Tons 1,352	4,059	1,753	5,264	5,364	17,245
1	69	—	—	—	—	—	—	—	—	598	13,087
—	—	103	309	—	—	235	453	224	785	872	2,697
7,165	5,374	1,605	1,204	1,874	1,405	1,501	710	3,405	1,080	19,678	11,437
19,900	17,413	20,371	17,825	12,776	11,179	32,013	28,012	25,216	18,725	171,202	135,998
1,209	1,934	1,635	2,616	1,967	3,442	2,513	4,888	777	1,463	18,340	30,725
71,723	22,413	74,641	23,325	68,464	21,395	72,209	34,813	45,398	15,994	528,689	169,302
80	160	166	332	150	300	440	666	273	508	1,109	1,966
—	—	—	—	37½	337	—	—	—	—	37½	337
28	28	40	80	78	156	30	60	146	939	1,241	2,748
—	—	—	750	—	500	—	7,175	—	20,000	—	28,425
385	1,023	158	474	1,217	3,956	2,816	11,849	1,243	4,703	7,181	25,914
4,614	5,536	5,013	5,839	5,101	6,064	8,074	10,773	5,950	8,982	57,885	67,530
—	—	—	—	—	—	—	—	—	—	5 416	5,830
64,000	80,000	66,400	83,000	46,858	93,716	88,519	177,038	69,174	138,348	648,251	777,389
5,965	13,421	6,919	10,378	6,190	8,820	6,746	9,613	2,179	3,105	54,020	80,182
—	—	—	—	—	—	75	150	40	80	205	346
—	1,001,885	—	1,212,874	—	1,460,674	—	1,451,498	—	771,995	—	8,603,465

MINING OPERATIONS DURING THE HALF-YEAR ENDING DECEMBER 31st, 1919.

AREA AT PRESENT HELD UNDER MINING ACTS (DECEMBER 31ST, 1919).

Nature of Holding.	Number.	Area.
Mineral leases	319	14,507 acres
Gold leases	50	957 "
Miscellaneous leases	97	22,173 "
Coal and oil leases	—	—
Mineral claims	251	9,955 "
Occupation licences	203	101½ "
Search licences	47	81,920 "
Coal and oil claims	23	14,720 "
Gold claims	3	10 "
Precious stones claims	7	3¼ "
Total holdings	1,000	144,346¾ acres

REGISTERED FROM JULY 1ST, 1919, TO DECEMBER 31ST, 1919.

Miscellaneous leases	10	2,621 acres
Mineral leases	9	250 "
Gold leases	2	40 "
Mineral claims	47	1,625 "
Coal and oil claims	11	7,040 "
Occupation licences	1	½ "
Search licences	29	18,560 "
Miners' rights	450	—
Precious stones claims	7	3¼ "
Total	566	30,139¾ acres

MEN EMPLOYED.

Estimated number of men employed in mining and mineral works, December 31st, 1919 :—

Copper	400
Gold	100
Salt and Gypsum	500
Other minerals	300
Smelting works, etc.	1,700
Total	3,000

GENERAL NOTES.

Reports, as under, will be found:— Page.

Average prices per ton of standard copper—

	£	s.	d.
For the six months ended June 30th, 1919	81	3	8
For the six months ended December 31st, 1919	100	15	0
For the year 1919	90	19	3

The following paragraph, which appeared in Review No. 30, is republished in order that a clear idea of the copper conditions during the whole of the year 1919 may be readily grasped:—

"Soon after the cessation of the war the market price of standard copper dropped from an average of £115 11s. 6d. per ton for 1918 to an average of £83 7s. for the first three months in 1919. This meant that the Wallaroo and Moonta Company was obliged to practically cease productive operations, retaining only enough hands (about 400) to keep the mines unwatered, and generally to keep all the properties of the company in the spic and span neatness and apple-pie order which have been such distinguishing features of the company's holdings for many years. This is the most serious break in the continuity of operations since the companies, *i.e.*, the Moonta and the Wallaroo, amalgamated in 1889. There was a break in 1910 for 10 weeks in consequence of a coal strike in New South Wales, and a few years further back a stoppage for a week occurred for the same reason.

"The copper market now is in better condition, and it is anticipated that as soon as coal supplies can be obtained operations will be resumed."

Continuing the history of the copper position to date, the Wallaroo and Moonta recommenced operations in the middle of September. After such a lengthy period of inaction it of course took some time for the men to return to the district, and consequently for a normal output to be quickly reached. Operations continued, and were satisfactory to all parties, till the end of the year; but, unfortunately, a further maritime strike interfered with work after the Christmas holidays.

The year 1919 has been a most unsatisfactory one for all concerned in copper in this State, as shortage of fuel, the result of labor troubles in other States, prevented the adoption of a policy of large production during the period when good prices (*vide* monthly quotations) could have been obtained.

The market prices range high at present, but the maintenance of them is a matter outside Australian influence or control.

The sliding scale of wages at the Wallaroo and Moonta, details of which were given in Review No. 30, was, in consequence of the award made by the Federal Arbitration Court, discontinued by notice on October 21st, 1919, as under:—

"As previously intimated, the altered scheme of wage payments in accordance with the Federal Arbitration Court award will be brought into force, and the hitherto satisfactory form of profit sharing covered by the sliding scale and regulated by the price of copper, will be discontinued. The Board regrets that such a course is necessary, especially as the method has proved so beneficial and serviceable over a long period. The question as to the future policy in this direction is having consideration."

On December 23rd, 1919, a further notice was issued by the Company:—

"With reference to the notice dated October 21st, 1919, in which employees were informed that consideration was being given to a scheme whereby they

would participate in the profits of the Company, the Board of Directors now intimate that the following method has been decided upon:—In the event of the shareholders receiving dividends during the financial year of the Company amounting to 10 per cent. or more on the paid-up capital, the employees to receive a bonus in cash computed to the last day of the financial year (June 30th) equal to 20 per cent of the total dividends distributed. The distribution to be, so far as possible, proportionate to the aggregate of the wages paid (excluding overtime) to each employee entitled to participate. This bonus to be paid only to those employees who have been in the employment of the Company for at least six months in such financial year, and whose conduct has been satisfactory to the management. Provided that death or *bona fide* sickness shall not disqualify a man from the benefits of the scheme. In any case of doubt as to the division of the bonus the decision of the management shall be final. If during the period any award of an Industrial Court be made affecting the wages or conditions of the workmen materially affecting the interests of the Company, or if the workmen or any section thereof shall have recourse to means to obtain alterations of their wages or conditions other than those provided by the industrial laws, the Directors shall be at liberty to determine that, either as to the whole or part of such employees, the proposed distribution shall not take place, and the undistributed funds set aside shall revert to the Company. This notice is subject to variation or cancellation by the Directors at their discretion without notice."

The following additional notice was issued by the Company on January 21st, 1920:—

"The Directors desire to intimate that, having regard to the present high cost of living, due to the recent material increase in the prices of commodities, as indicated by the Commonwealth Statistician's latest figures, it has been decided, in order to meet such existing increase, to pay all adult employees an additional sixpence a day on the existing rates as from Monday, January 19th, 1920."

Reports show that despite the difficulty in marketing copper ore under the existing conditions a certain amount of copper mining has been in progress at the following mines:—

North.—Nuccalena, Blinman; Diamond Jubilee, Nichol's Nob; Yudnamutana; Paull's; Barilla; Wild Dog; Belliak; Last Chance; Breaden Hill; and others.

North-East.—Dome Rock, Lovely Gully, and Paratoo.

Only a little work has been done at Yudnamutana, but advice has been received that the English company is taking steps to obtain capital and work the mines.

The Mount Gunson Copper Company has finally ceased operations.

The value of the mineral production of the State for 1919, so far as can be ascertained, is £771,995, which is a very satisfactory total, and compares well with the previous years, when it is remembered that the value of the copper production for the year is nearly £600,000 less than that of 1918.

Deloraine Gold Mine.—The amount of ore treated during the six months is 2,177 tons for 1,065ozs. gold bullion, worth £3,948, and 16cwts. copper, worth £84.

No development work has been done during the six months, all payable ore from the lower levels having been mined. The pumps were stopped in December, and the water allowed to rise in the lower levels.

Operations are still in progress at another part of the mine.

Some of the returns recently obtained from the crushing of parcels of ore at the Government batteries have been of a very satisfactory and encouraging character. Attention may be drawn to the following.

Two parcels from the *Emily Gold Mine,* near Williamstown, returned as follows:—Nine tons 16cwts. yielded 10ozs. 16dwts. 17grs. of gold bullion, the yield per ton being 85s.; and 6½ tons yielded 5ozs. 14dwts. 13grs. of gold bullion, the yield per ton being 64s.

Three tons from the *Hidden Secret Mine,* near Birdwood, returned 28ozs. 13dwts. 21grs. of gold bullion, the yield per ton being 690s. A previous parcel of 20½ tons from this mine returned 218ozs., valued at £841. These parcels were all treated at the Mount Torrens battery.

Two parcels from the *Homeward Bound Mine,* Mannahill, returned 6 tons 6cwts., yielding 14ozs. 14dwts. 23grs. gold bullion, equal to 182s. per ton; and 4 tons 1cwt. gave 16ozs. 5dwts. 8grs., equal to 310s. per ton.

A parcel from the *New Glenloth Company,* treated at the Glenloth battery, returned 24ozs. 6dwts. 21grs. gold bullion, the yield per ton bein 199s.

At Tarcoola a parcel of 43 tons from the *Perseverance Mine* returned 75ozs. 17dwts. 4grs., valued at £258 7s. 11d., the yield per ton being 120s. The Government battery has treated to date from this mine 2,004 tons for 3,403ozs. gold bullion, valued at £12,677.

Further inquiries for the treatment of ore from Angaston, Teetulpa, Mannahill, Williamstown, Woodside, Tarcoola, and Glenloth show that mining and prospecting operations are being carried out over a large area.

At the *Talisker Mine* the holders have erected pumping plant, consisting of one powerful engine and two 10in. pumps. Certain obstructions have caused delay, but new pipes are now being put down and other arrangements are being made which, it is hoped, will give greater satisfaction.

Stuart's Range Opal Field, being situated in a dry district, can only be worked intermittently, but it is estimated that opal to the value of £20,000 has been found during 1919.

The returns from *salt, gypsum, barytes,* and *phosphate rock,* despite the difficulties of transit, due to industrial troubles, have been highly satisfactory.

The attention now being given to the exploitation of these and other non-metallic minerals, with which the State is exceptionally well endowed, by both local and interstate investors, indicates that these permanent branches of the mineral industry will not only maintain in importance, but will increase

Graphite.—Development in the leases of the Uley Graphite Syndicate during the half year has proved a considerable tonnage of good grade ore containing flake of high quality (*vide* page 52).

Plans are in hand for the erection of a mill by the Syndicate to produce high-grade concentrates, and the coming year should see this important mineral appearing in the list of non-metallic products of the State for the first time.

REWARD FOR DISCOVERY OF PETROLEUM OIL.

The following proclamation by the Commonwealth Government is re-published for general information:—

[Extract from *Commonwealth of Australia Gazette,* No. 1, dated January 2nd, 1920.]

Prime Minister's Department,

January 2nd, 1920.

REWARD BY THE COMMONWEALTH GOVERNMENT FOR THE DISCOVERY OF PETROLEUM OIL IN COMMERCIAL QUANTITIES IN AUSTRALIA.

A reward of £10,000 will be paid by the Commonwealth Government for the discovery of petroleum oil in commercial quantities in Australia, subject to the following conditions:—

(1) Any person* who is engaged in boring for oil in Australia, and who desires to be considered as a possible claimant for the reward shall—

(*a*) within two months after this date, if he has already begun boring,

(*b*) within two weeks from the date of his commencing boring,

notify the Minister for Home and Territories in writing at his office in Melbourne. He shall at the same time furnish the following information:—

Precise locality of bore;

If any work done, a full statement relating thereto, including complete and technically correct daily records of strata passed through, sizes of casing and lengths of each size, particulars with regard to the striking of water, fresh, salt, or otherwise, mineralized, hot springs, showings of gas and oil.

(2) He shall, at intervals of not less than one month from the date of above notification, send to the Minister for Home and Territories, and to the Minister for Mines in the State in which he is boring, a full report of all work done on or in connexion with the bore since last report.

(3) The Minister for Home and Territories, and the Minister for Mines for the State, or either of them, may authorise any officer to visit the bore, inspect all operations and records, examine all material extracted from the bore hole, satisfy himself that proper steps are being taken to insure

* The word "person" includes person, firm, or company.

maximum production and to prevent flooding by water of possible oil-bearing strata, examine storage tanks, take test samples at various depths, and make tests with standard apparatus to ascertain the quantity of water present.

Every facility shall be afforded by the claimant and his employees to such officer to make such investigations as he may deem fit.

(4) Should any oil-bearing strata be passed through in the course of boring operations, samples of the oil shall be taken, and not less than 2galls., free from water and other removable impurities, shall be sent to the Minister for Home and Territories and the Minister for Mines in sealed receptacles, with properly authenticated certificates as to the manner in which the oil was obtained.

(5) No payment of the reward shall be authorised unless it is proved to the satisfaction of the Minister that oil to the extent of 50,000galls. has been obtained, and that the bore is still flowing freely and producing oil in commercial quantities.

(6) If any dispute arises—

(*a*) as to who is entitled to the reward; or

(*b*) as to the manner in which the reward is to be distributed in cases where there are more claimants than one; or

(*c*) whether the conditions to be fulfilled in order to entitle the claimant to the reward have been fulfilled; or

(*d*) in any way concerning the claim to be a *bona fide* discoverer of oil in commercial quantities or for reward;

the Minister for Home and Territories may determine the dispute, and his decision shall be final and conclusive.

W. M. HUGHES, Prime Minister.

DEPARTMENT OF MINES.

"THE NATIVE INDUSTRIES ENCOURAGEMENT ACT, 1872."

NOTICE OF THE OFFER OF A BONUS FOR THE DISCOVERY OF OIL.

Adelaide, December 19th, 1918.

A bonus of £5,000 is offered to the person or body corporate which first obtains from a bore or well situated in the State of South Australia 100,000galls. of crude petroleum, containing not less than 90 per cent. of products obtainable by distillation,

No application for a bonus will be considered unless the following conditions have been strictly complied with :—

1. The applicant for the bonus must have furnished to the Minister of Mines during the progress of drilling operations—

(*a*) A monthly record of work done ;

(*b*) A full log of all bores and wells sunk, whether successful or unsuccessful

(*c*) Samples of materials passed through by the bores, to be taken at every 50ft. sunk, and also at every change of country encountered ;

(*d*) A declaration pursuant to "The Statutory Declarations Act, 1835," of the exact locality of each bore or well. (This should be furnished with the first monthly report on the bore or well.)

2. The oil must have been stored at the bore or well from which it has been obtained until the whole 100,000galls. has accumulated.

3. The applicant must furnish with his application—

(*a*) The certificate of a licensed surveyor nominated by the Minister of Mines as to the quantity of oil so stored ;

(*b*) The certificate of the Government Analyst of the result of his analysis of samples of the oil taken by a person nominated by the Minister of Mines ;

(*c*) A declaration pursuant to "The Statutory Declarations Act, 1835," that the whole of the oil for which the bonus is claimed was obtained from the bore or well where it is stored.

4. Within 24 hours of the first discovery of oil in the well or bore, notice of such discovery must be sent to the Minister of Mines.

5. Any person who desires at any time to inspect or test the well or bore on behalf of the Minister of Mines must be granted every facility for this purpose.

6. The applicant must have done nothing contrary to the provisions of "The Mining Act, 1893," or "The Mining Act Amendment Act, 1900," or of any lease or licence granted to the applicant under either of these Acts.

W. H. HARVEY, Minister of Mines.

DEPARTMENT OF MINES.

"THE NATIVE INDUSTRIES ENCOURAGEMENT ACT, 1872."

NOTICE OF THE OFFER OF A BONUS FOR THE PRODUCTION OF GRAPHITE.

Office of the Minister for Mines, Adelaide, March 13th, 1919.

It is hereby notified that, pursuant to the powers conferred by the Act No. 30 of 1872, and of all other powers in that behalf, a bonus will be paid by the Government, on the conditions hereinafter stated, to persons who actually recover and sell graphite in the market. The bonus and the conditions will be as follows:—

1. A bonus of one pound (£1) per ton on marketable graphite will be paid to any person or body corporate producing such graphite from a mine in South Australia.

2. Such bonus will be paid on the production, to the approval of the Minister of Mines, of account sales of graphite sold prior to the 30th day of June, 1922.

3. Every applicant for the payment of a bonus shall lodge with the said Minister a declaration, made pursuant to the Statutory Declarations Act, 1915, that the whole of the graphite for which such bonus is claimed was produced in South Australia, and stating the exact locality where the same was obtained.

W. H. HARVEY, Minister of Mines.

SOUTH AUSTRALIAN ROOFING SLATES.

Offer of Bonuses.

The Government of the State of South Australia have directed that it be made known that it is their intention to offer bonuses to the producer or producers of roofing slates of best approved quality. The slates must be the product of *bona fide* slate quarries situated within the State, and they must be approved by the Superintendent of Public Buildings or an officer nominated by him for the purpose.

This offer is made only in connection with the first 300,000 slates, and is limited to slates produced and approved as before mentioned within the term of two years from October 1st, 1919.

The bonuses offered are as follows:—£3 per thousand for the first 100,000, £2 per thousand for the second 100,000, and £1 per thousand for the third 100,000 of such slates—a possible total of £600.

Bonuses will not necessarily be paid exclusively to any one producer; for example, if of the first 100,000 slates half are produced by one and half by another producer, they will share equally in the first £300.

It is to be distinctly understood that no claim for any bonus will be recognised unless the slate is as good at least in quality as the standard sample now in the possession of the Superintendent of Public Buildings, which may be inspected by arrangement with that officer, nor unless the slate is passed by the Superintendent of Public Buildings for the time being; and that the certificate of that officer and as to what (if any) claims, and which claims (in case of competition) are to be recognised, shall be final; and that he will not consider any claim unless all such facilities as he may require are furnished in order that he may be able to satisfy himself as to the genuineness of the claim and that all conditions have been fulfilled.

If any roofing slates which are inferior in quality to the standard sample above mentioned are dispatched by any producer from his quarry no bonus will be paid in respect of any part of the load of slates contained in the truck or other vehicle in which such inferior slates are dispatched. If any producer dispatches, whether at the same time or at different times, more than three loads containing inferior slates, as aforesaid, no bonus will be paid to such producer in respect of any of the slates at any time despatched by him.

George Ritchie, Commissioner of Public Works.

CRUSHING AND CYANIDING PLANTS.

RETURNS FROM GOVERNMENT CRUSHING AND CYANIDING PLANTS FOR THE HALF-YEAR ENDED DECEMBER 31ST, 1919.

Name of Mine.	Locality.	Weight of Ore.	Gold Bullion Recovered.	Total Value of Gold Bullion.	Yield per Ton, in Shillings.
		Tons cwts. qrs.	Ozs. dwts. grs.	£ s. d.	s.
MOUNT TORRENS BATTERY AND CYANIDE WORKS.					
Emily	Williamstown	9 16 0	10 16 17	41 13 8	85
Sims' Section	Mt. Torrens	6 0 0	0 15 12	2 8 10	8
Emily	Williamstown	6 10 0	5 14 13	20 17 8	64
"	"	5 13 0	0 9 0	1 10 8	5
Sec. 121	Taluuga	3 15 0	2 2 9	7 15 6	41
Hidden Secret	Birdwood	3 0 0	28 13 21	103 11 5	690
Emily	Williamstown	10 0 0	7 4 16	25 1 5	50
Total		44 1 40	55 16 16	202 19 2	94
Grand total since starting of battery		11,348 10 3	6,829 11 18	25,688 18 11	45/3
PETERBOROUGH BATTERY AND CYANIDE WORKS.					
Milparinka	New South Wales	3 15 0	0 10 2	1 13 6	9
Homeward Bound	Mannahill	6 5 0	14 14 23	56 18 9	182
"	"	4 1 0	16 5 8	62 17 6	310
Total		14 1 0	31 10 9	121 9 9	161
Grand total since starting of battery		5,335 18 0	4,881 14 16	18,157 13 11	68
TARCOOLA BATTERY AND CYANIDE WORKS.					
Tarcoola Perseverance	Tarcoola	43 0 0	75 17 4	258 7 11	120
"	"	36 0 0	21 13 13	67 14 10	37
Royal George	"	49 10 0	9 14 4	30 11 7	12
Total		128 10 0	107 4 21	356 14 4	56
Grand total since starting battery		8,765 15 3	11,385 4 10	40,109 9 1	91
GLENLOTH BATTERY AND CYANIDE WORKS.					
New Glenloth Mining Company	Glenloth	7 0 0	24 6 1	69 15 8	199
Grand total since starting of battery		3,330 12 0	2,529 6 19	8,483 5 0	51

RETURNS FROM CRUSHING AND CYANIDING PLANTS (OTHER THAN GOVERNMENT) FOR THE HALF-YEAR ENDED DECEMBER 31ST, 1919.

Name.	Ore Treated.			Gold Bullion Recovered.			Value.			Yield per Ton, in Shillings.
	Tons	cwts.	qrs.	Ozs.	dwts.	grs.	£	s.	d	s.
DELORAINE GOLD MINE.										
Deloraine	2,177	0	0	1,065	0	0	3,948	2	0	—
*Total	2,177	0	0	1,065	0	0	3,948	2	0	36

* Also 16 cwts. copper, worth £83 18s. 7d.

TOTAL BATTERY AND CYANIDE RETURNS FROM ALL PLANTS FOR SIX MONTHS ENDED DECEMBER 31ST, 1919.

Name.	Ore Treated.			Gold Bullion Recovered.			Value.			Yield per Ton, in Shillings.
	Tons.	cwts.	qrs.	Ozs.	dwts.	grs.	£	s.	d.	s.
Mt. Torrens	44	14	0	55	16	16	202	19	2	91
Peterborough	14	1	0	31	10	9	121	9	9	161
Tarcoola	128	10	0	107	4	21	356	14	4	56
Glenloth	7	0	0	24	6	21	69	15	8	51
Deloraine	2,177	0	0	1,065	0	0	3,948	2	0	36
Total	2,371	5	0	1,283	18	19	4,699	0	11	39

SUMMARY SHOWING TOTAL ORE TREATED AT STATE BATTERIES AND CYANIDE WORKS TO DECEMBER 31st, 1919, FROM MINES HEREUNDER.

Name of Mine.	Locality.	Weight of Ore.			Gold Bullion Recovered.			Total Value of Bullion.			Yield per Ton, in Shillings.
		Tons.	cwts.	qrs.	Ozs.	dwts.	grs.	£	s.	d.	s.
Associated	Tarcoola	50	13	0	43	6	5	152	18	3	60
Ajax	Waukaringa	125	10	0	89	3	7	347	19	9	55
Angepena Treasure	Mount Serle	4	7	0	17	10	3	69	7	5	318
Block 245	Wadnaminga	4	16	0	9	16	10	33	18	8	141
Block 249	Wadnaminga	4	13	0	4	15	12	17	8	10	74
Bohun	Tarcoola	93	15	0	27	16	23	99	14	0	21
Barossa Cement	Barossa	98	10	0	28	9	3	114	16	6	23
Banksia	Woodside	219	17	2	180	13	7	698	11	6	63
Blumberg	Birdwood	699	12	0	600	7	22	2,257	8	4	64
Blumberg Proprietary	Birdwood	481	2	0	213	6	4	769	17	4	32
Brind	Woodside	127	16	3	44	18	4	153	0	8	23
Bird-in-Hand	Woodside	154	11	0	48	6	2	248	5	2	32
Boomerang	Outalpa	80	15	0	69	12	16	227	19	6	56
Blunsdens	Peterborough	39	19	0	3	0	19	9	14	0	4
Brilliant	Macaw Creek	9	2	0	8	15	8	29	5	10	64
Crane's Reef	Birdwood	120	12	0	41	2	10	152	7	11	25
Curdnatta	Tarcoola	777	1	0	943	3	6	3,472	4	6	89
Cobra	Birdwood	7	3	0	1	15	4	5	6	0	14
Crown	Birdwood	264	1	3	130	7	22	466	8	0	35
Copperlinka	Olary	165	3	0	111	3	0	419	3	6	50
Day Dawn	Tarcoola	983	13	0	1,546	14	19	5,172	13	7	105
Dark Hill	Near Tarcoola	25	10	0	6	3	17	20	15	9	16
Duchess Neindorf	Tweedvale	52	4	0	54	5	4	198	0	8	75
Deloraine	Kersbrook	482	12	2	569	16	23	2,116	18	8	87
Dart's Syndicate	Mt. Torrens	64	14	0	19	0	0	74	0	0	22
Durdan	Birdwood	217	16	2	83	16	12	316	10	4	29
Diamond Jubilee	Silverton, N.S.W.	12	6	0	4	7	7	13	5	10	21
Dustholes	*Vide* Myrtle		—			—			—		—
Emily	Williamstown	31	19	0	24	4	22	89	3	5	55
Esmonde	Wadnaminga	30	10	0	34	1	11	126	10	1	83
Eureka	Woodside	708	0	3	448	10	2	1,446	11	8	40
Evening Star	Tarcoola	11	2	2	14	5	23	42	19	0	77
Eclipse	Tarcoola	42	4	0	35	8	16	124	10	10	59
Eudunda Hope	Mannahill	32	15	0	7	18	13	30	13	4	18
Federal	Tarcoola	44	3	0	2	6	0	7	1	4	3
Federal	Woodside	41	1	0	20	16	11	81	18	6	39
Flagstaff	Birdwood	10	2	0	3	16	9	14	2	8	28
Fabian's Glenloth	Glenloth	18	10	0	18	18	13	72	17	7	78
Fabian's No. 2	Glenloth	31	13	0	14	5	4	45	12	8	28
Fabian's No. 3	Glenloth	959	3	0	1,215	10	9	4,096	14	11	86
Great Eastern	Wadnaminga	21	16	0	31	10	21	109	15	5	100
Gallipoli	Tarcoola	140	1	0	191	17	4	656	7	2	93
Government Mine	Tarcoola	445	6	0	1,024	16	22	3,386	1	1	152
Great Talunga (Black Snake)	Birdwood	369	4	3	225	7	15	834	0	1	45
Golden Gate	Angaston	159	4	0	283	9	8	1,185	15	8	149
Gowland's Reef	Mt. Torrens	101	8	3	29	11	4	106	7	3	21
Golden Thorpe	Woodside	205	17	0	86	18	10	342	4	6	33
Golden Junction	Mt. Grainger	226	15	0	151	16	8	578	18	7	51
Glen Markie	Glenloth	369	10	0	202	6	4	712	3	4	38
Great Glenloth	Glenloth	26	10	0	5	19	11	22	16	11	17
Glenloth Pioneer	Glenloth	37	19	2	29	5	9	106	18	8	56
Golden Stream	North-east	10	17	0	6	4	14	21	17	10	40
Glenloth Well	Glenloth	26	0	0	23	11	16	83	19	10	64
Golden Record	Wadnaminga	24	15	0	33	16	17	122	4	9	98
Hennig's	Parnaroo	98	12	0	22	11	10	78	0	3	15
Hall's Reef	Forest Range	50	10	0	68	10	1	247	13	11	98
Haklo	Birdwood	291	12	0	180	3	1	709	8	11	48
Homeward Bound	Mannahill	694	3	0	1,181	3	21	4,639	10	3	134

SUMMARY SHOWING TOTAL ORE TREATED, ETC.—*continued.*

Name of Mine.	Locality.	Weight of Ore.			Gold Bullion Recovered.			Total Value of Bullion.			Yield per Ton, in Shillings.
		Tons.	cwts.	qrs.	Ozs.	dwts.	grs.	£	*s.*	*d.*	*s.*
Hidden Secret	Birdwood	77	4	0	429	19	2	1,654	9	11	430
Hidden Treasure	Tarcoola	52	10	0	36	14	5	117	8	1	45
Ironclad	Mt. Grainger	12	6	0	11	18	9	44	9	5	72
Klondyke	Mannahill	36	11	0	82	0	10	321	3	8	175
Kitticoola	Palmer	14	15	0	18	17	8	69	5	11	94
Kirkeek's Treasure	Nillinghoo	485	0	0	780	11	9	2,845	15	0	117
King's Bluff	Olary	127	0	0	250	0	0	750	0	0	118
Lake Labyrinth	25 miles E. of Tarcoola	64	10	0	56	10	11	207	2	3	64
Last Resource	Tarcoola	152	15	0	108	9	20	384	1	9	50
Lease 938	Tarcoola	9	10	0	3	13	18	12	5	4	25
Lease 1022	Tarcoola	12	4	0	8	13	18	23	17	9	39
Lucky Hit	Birdwood	338	16	1	303	6	3	1,148	2	11	67
Little Crumb	Birdwood	77	11	2	136	14	7	516	5	7	133
Lux	Olary	265	8	0	156	4	21	550	17	0	41
Lady Alice	Barossa	24	1	0	49	15	22	195	13	4	162
Lady Edith	Peterborough	10	0	0	1	6	0	4	9	4	9
Lone Hand	Glenloth	446	10	0	522	5	1	1,840	11	11	82
Lake View	Glenloth	18	7	0	25	3	10	88	6	2	96
Last Chance	North-east	11	0	0	2	18	11	11	3	3	20
Morning Star	Tarcoola	307	0	0	555	15	7	1,876	4	10	122
Menzies Barossa	Barossa	23	14	0	15	1	14	52	10	0	44
Mount Torrens	Mt. Torrens	1,252	11	0	652	10	16	2,483	18	5	39
Mount Grainger	Mt. Grainger	690	3	1	725	17	14	2,872	8	6	83
Myrtle (Dustholes)	Mt. Grainger	282	7	1	109	6	23	387	14	5	27
Mount Mitchell	Glenloth	28	9	0	7	6	6	23	5	5	16
Medora	Mt. Grainger	200	0	0	182	6	23	694	9	9	69
Miners Dream	Mt. Grainger	18	13	0	9	3	18	33	11	10	35
Mount Paratoo	Paratoo	50	0	0	5	0	16	15	7	0	6
Mount Lyndhurst	Lyndhurst	1	8	0	0	7	1	1	3	11	16
New Era	Woodside	794	18	0	455	6	13	1,756	6	2	44
New Eclipse or LeHunte	Woodside	189	5	0	141	13	23	529	16	9	56
New Milo	Wadnaminga	206	5	0	256	4	14	883	12	9	85
Nectar	Mannahill	18	14	0	28	10	23	109	2	2	116
Nil Desperandum	Glenloth	69	0	0	21	13	17	75	3	3	21
Nackra	Nackra	36	18	0	7	2	21	25	5	3	13
Outalpa	Outalpa	90	9	0	53	18	16	184	1	3	40
Perseverance (Gourlay's Claim)	Earea Dam	34	10	0	16	7	11	62	17	7	36
Proprietary	Tarcoola	6	0	0	3	8	8	10	13	6	35
Pioneer	Callington	97	2	0	31	8	20	120	16	9	24
Phoenix	Gawler	11	15	0	6	6	8	21	9	6	36
Royal Charlie	Mannahill	20	7	0	5	10	5	15	19	1	15
Royal George	3 m.W. Tarcoola	1,027	7	0	576	8	3	2,102	5	3	41
Railway	West Australia	14	2	3	15	0	23	51	16	2	73
Royal Tiger	Glenloth	53	5	0	32	5	15	115	4	10	43
Ruby	Barossa	16	2	0	23	7	23	88	13	4	110
Reddaway's	Mt. Torrens	150	2	1	40	2	9	131	3	4	17
Scotchman	Teetulpa	14	17	0	9	18	20	34	4	8	46
Schuppan	Lyndoch	8	0	0	2	5	4	8	3	2	20
Section 121	Hd. of Talunga	3	15	0	2	2	9	7	15	6	41
Spanish American	Mannahill	21	3	2	10	12	11	39	6	3	37
Shamrock	Tarcoola	48	0	0	77	13	23	303	1	9	126
Sims Section	Mt. Torrens	73	18	0	13	0	0	46	11	11	12
Schubert's Reef	Mt. Torrens	95	18	0	54	5	2	187	15	4	39
South Knappa	Woodside	7	13	0	3	7	11	13	2	6	34
Stars and Stripes	Mt. Grainger	20	3	0	5	18	10	22	17	7	22
Triumph	Wadnaminga	17	18	0	8	11	17	32	4	3	35
Tarcoola Blocks	Tarcoola	650	3	0	950	12	8	2,917	8	9	82
Tarcoola Blocks, Enterprise Lease	Tarcoola	402	11	1	484	10	20	1,661	19	5	89

SUMMARY SHOWING TOTAL ORE TREATED, ETC.—*continued.*

Name of Mine.	Locality.	Weight of Ore.			Gold Bulli Recovered.			Total Value of Bullion.			Yield per Ton, in Shillings.
		Tons.	cwts.	qrs.	Ozs	dwts.	grs.	£	s.	d.	s.
Tarcoola United	Tarcoola	56	10	0	100	0	15	331	4	3	117
The Gem	Tarcoola	42	12	0	90	6	19	277	16	11	130
Tarcoola West	Tarcoola	53	5	0	63	14	4	253	5	11	95
Tarcoola Perseverance	Tarcoola	2,040	4	3	3,425	13	8	12,755	10	9	127
Tolmer's Hill.....	Tarcoola	6	0	0	1	11	16	5	8	0	18
Union Jack	Waukaringa ..	17	2	0	2	16	13	9	18	9	11
Ulooloo	Ulooloo	28	5	0	13	5	11	52	19	0	37
Vienna (Descovitch's Reef)	Mt. Pleasant ..	29	3	0	14	0	3	47	15	7	32
Virginia	Wadnaminga .	13	1	0	18	10	14	68	6	1	104
Warrigal South	Tarcoola	73	12	3	107	2	12	341	1	6	92
Wondergraph	Tarcoola	30	5	0	57	0	4	200	4	6	132
Warrigal	Tarcoola	118	17	0	134	16	4	347	18	5	58
Wilgena Syndicate ..	Tarcoola	29	15	0	23	15	12	88	10	7	59
Wilgena Enterprise ..	Earea Dam....	348	8	0	323	7	22	1,279	8	2	73
Wilgena Associated ..	Tarcoola	45	0	0	98	10	10	364	3	11	161
Wheal Ellen	Strathalbyn ...	68	0	0	18	9	5	62	8	11	18
Welsh Prince.....	Wadnaminga ..	10	0	0	3	10	13	12	8	0	25

COPPER.

AVERAGE MONTHLY PRICE OF COPPER, JANUARY TO DECEMBER, 1919.

	Standard.			Best Selected.			Electrolytic.		
	£	s.	d.	£	s.	d.	£	s.	d.
January.....	*93	9	9	105	13	4	*106	2	9
February	78	10	3	89	6	3	91	11	0
March	76	17	7	79	15	0	*79	17	2
April	*77	7	0	81	18	11	*82	0	3
May	77	16	8	81	13	11	81	11	10
June	*83	0	6	86	2	6	*86	16	0
July	99	14	5	102	14	5	107	14	0
August	97	11	4	108	16	8	113	4	9
September.....	100	17	5	109	5	7	115	5	11
October	103	11	0	113	10	0	117	3	6
November.....	98	18	9	111	2	6	113	7	0
December ...	103	17	2	113	7	6	114	6	8
Average.....	90	19	3	98	8	10	100	15	1

* Revised figures *vide* Review No. 30.

AVERAGE PRICE OF STANDARD COPPER FOR THE LAST TEN YEARS.

	£	s.	d.		£	s.	d.
1910	57	3	3	1915	72	12	9
1911	56	1	10	1916	116	1	3
1912	73	1	3	1917	125	2	4
1913	68	5	8	1918	115	11	6
1914	60	8	1†	1919	90	19	3

Average for the 10 years, £83 10s. 8d.

† Quotations for nine months only.

GOVERNMENT DRILLING OPERATIONS.

REPORT BY THE SUPERVISOR OF BORING OPERATIONS.

During the half-year ended December 31st, 1919, the No. 1 diamond drilling plant was continuously employed at Moonta on the work of testing the extensions of the Eastern or Wild Dog lode, within the Yelta reserve.

This drill, in charge of Mr. A. W. Matthews, Engineer for Boring, was located during the early part of the period under review in the north-eastern portion of Block No. 1 (see plan on page 10 of Mining Review No. 28). This borehole, No. 20 of the Yelta series, attained a total depth of 809ft. It traversed felspar porphyry throughout its whole course, and met with only traces of vein matter. Narrow veinlets of quartz were seen at 384ft., 465ft., 474ft., and 805ft. This quartz was associated with specks of pyrites and a little haematite, but no copper ore was seen below the depth of 330ft., as recorded in Mining Review No. 30, page 22.

On the completion of this hole the drill was moved to a site in Block No. 2 to test the same lode at a point between the underground workings of Messrs. Wallis and Party and the Moonta Mines boundary. The borehole, No. 21 of the series, showed felspar porphyry to a depth of 134ft., where the lode was cut. Between 134ft. and 138ft. the siliceous lode matter contained a little pyrite and chalcopyrite, but the core was judged to be too poor in copper to be worth assaying. On the footwall of this lode there was proved a large body of quartz and pegmatite extending from 138ft. to 165ft. A little felspar porphyry was associated with the siliceous vein matter over the whole width of the formation, but only slight traces of pyrite and chalcopyrite were seen. Haematite is present on the joints. The work of drilling was stopped in felspar porphyry at 174ft. The drill was then moved to the site of No. 22 borehole, 140ft. to the north of the last site, and a commencement was made to bore before the end of the year.

The Calyx drill, in charge of Mr. C. F. Duffield, Engineer for Boring, continued the work of testing the Leigh Creek coal field at a site intermediate between the mine workings and the township of Copley. This hole was continued until the coal measures were completely traversed and the bedrock beneath them was entered. The coal measures consisted chiefly of shales, more or less cabonaceous throughout, and bearing impressions of Mesozoic plant remains. Interbedded with the shales were a number of narrow bands of clay ironstone.

At 711ft. from the surface the main seam was entered, the bedding planes of the coal being inclined at an angle of 41° with the horizon. The seam carries at this place one band of sandy carbonaceous shale between depths of 728ft. and 729ft. The bottom of the seam was proved at 732ft. 6in.

Below this depth the strata consist of carbonaceous shales with small seams of coaly matter up to ½in. thick, and a small band of clay ironstone to a depth of 882ft. 6in.

At this depth a seam of coal was cut, and found to be 3ft. in thickness, with a dip of 39°. Below 885ft. 6in. carbonaceous sandstone with coal was traversed, and continued to a total depth of 912ft. In the last few feet the core exhibited a very steep dip.

At 912ft. argillaceous material was entered, and at 984ft. pale slate, with the bedding planes dipping at 54°, was entered. At this point the work of boring was discontinued.

The core recovered was analysed in detail with the following results:—

ANALYSIS OF CORE SAMPLES FROM MAIN SEAM, No. 6 BORE, LEIGH CREEK COALFIELD.

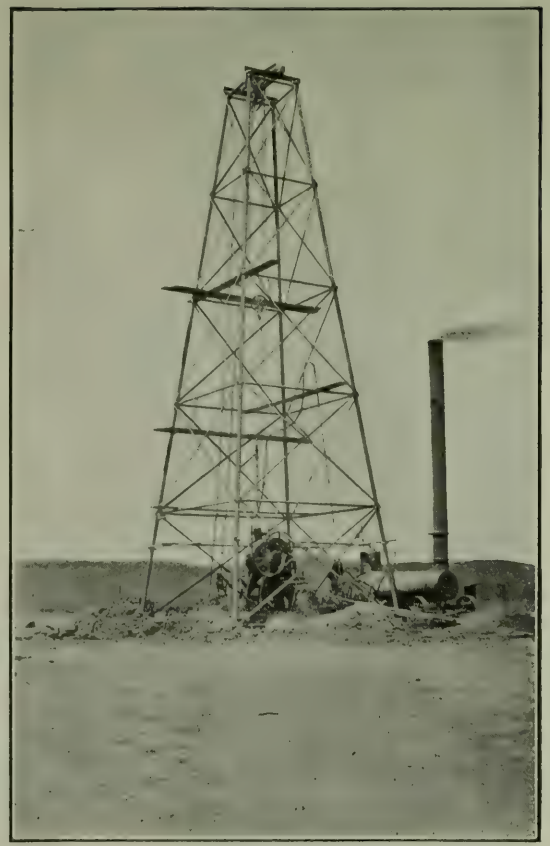
Analysis of Samples as Raised.

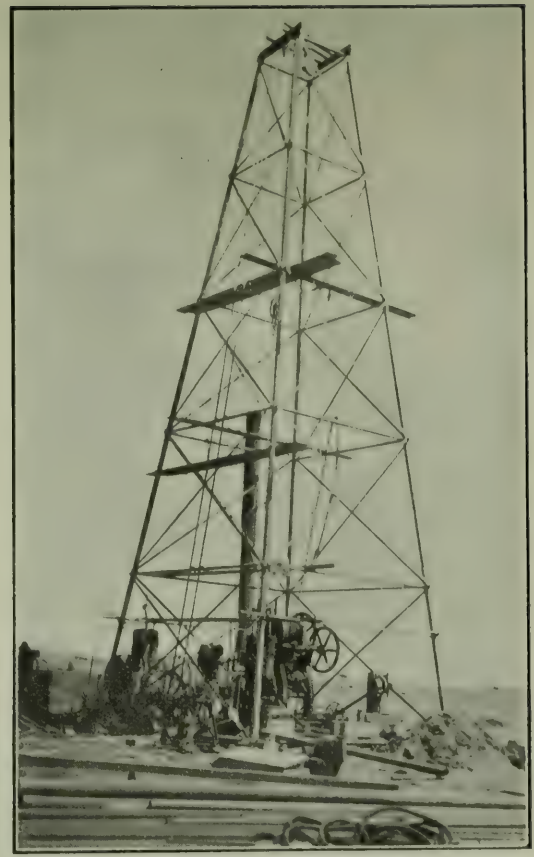
Number of Sample.	Depth from Surface in Feet.	Moisture at 105° C.	Volatile Matter.	Fixed Carbon.	Ash.
1	711–712	20·44	29·52	32·37	17·67
2	712–713	18·27	22·25	32·95	26·53
3	713–714	19·88	22·57	34·18	23·37
4	714–715	18·59	22·58	34·29	24·54
5	715–716	29·22	30·66	36·17	3·95
6	716–717	20·67	27·75	39·86	11·72
7	717–718	15·50	22·04	33·75	28·71
8	718–719	19·18	32·78	37·39	10·65
9	719–720	17·54	27·69	37·89	16·88
10	720–721	21·36	29·88	42·29	6·47
11	721–722	22·16	23·73	38·57	15·54
12	722–723	24·03	27·41	40·16	8·40
13	723–724	20·91	26·61	40·48	12·00
14	724–725	18·40	24·93	34·23	22·44
15	725–726	16·29	22·64	30·69	30·38
16	726–727	17·28	21·13	35·59	26·02
17	727–728	16·81	20·76	29·66	32·77
18	729–730	17·88	20·63	33·19	28·30
19	730–731	21·61	24·01	42·90	11·48
20	731–732	22·45	29·57	39·99	7·99
21	732–732·5	23·24	27·43	39·39	9·94
		421·69	536·57	765·99	375·75

Twenty samples are each 1ft.
One sample, No. 21, is 0·5ft.

Average of samples—

Moisture at 105° C.	Volatile Matter.	Fixed Carbon.	Ash.
20·00	25·50	36·40	18·08 for "as raised."





Face p. 26.] The Calyx Drill at Work, Leigh Creek, showing Derrick and Boiler.

ANALYSIS OF CORE SAMPLES FROM MAIN SEAM, No. 6 BORE, LEIGH CREEK COALFIELD.

Analysis of Samples, Air Dried.

Number of Sample.	Depth from Surface in Feet.	Moisture at 105° C.	Volatile Matter.	Fixed Carbon.	Ash.	Sulphur.
1	711–712	18·06	31·51	32·50	17·93	0·21
2	712–713	14·64	25·51	31·93	27·92	0·15
3	713–714	15·76	25·91	33·83	24·50	0·13
4	714–715	14·86	26·89	32·45	25·80	0·14
5	715–716	22·64	34·44	37·65	5·27	0·13
6	716–717	17·68	27·33	42·57	12·42	0·10
7	717–718	13·32	22·89	34·54	29·25	0·04
8	718–719	16·11	34·42	38·41	11·06	0·14
9	719–720	14·39	30·18	38·13	17·30	0·11
10	720–721	17·54	32·51	43·30	6·65	0·14
11	721–722	15·61	26·76	41·22	16·41	0·06
12	722–723	18·33	29·05	43·69	8·93	0·13
13	723–724	17·16	26·33	43·76	12·75	0·08
14	724–725	14·47	26·82	35·09	23·62	0·10
15	725–726	12·80	23·14	31·83	32·23	0·07
16	726–727	13·52	23·14	36·28	27·06	0·08
17	727–728	11·88	22·28	31·16	34·68	0·08
18	729–730	13·07	22·67	34·37	29·89	0·07
19	730–731	17·26	25·24	45·35	12·15	0·12
20	731–732	18·93	29·33	43·48	8·26	0·20
21	732–732·5	18·47	30·16	40·96	10·41	0·24
		336·50	576·51	792·50	394·49	2·52

Average of samples—

Moisture at 105° C.	Volatile Matter.	Fixed Carbon.	Ash.	Sulphur.
15·96	27·38	37·65	18·99	0·11

ANALYSIS OF COAL SAMPLES FROM LOWER SEAM, No. 6 BORE, LEIGH CREEK COALFIELD.

Number of Sample.	Depth from Surface in Feet.	Moisture at 105° C.	Volatile Matter.	Fixed Carbon.	Ash.
1	882·5–883·5	22·22	26·66	34·09	17·03
2	883·5–884·5	24·42	27·11	37·03	11·44
3	884·5–885·5	27·62	29·16	34·63	8·59

On the completion of No. 6 borehole at Leigh Creek the Calyx drill was dismantled, and diamond drilling was resumed. The drill was dispatched to the Wheal Ellen, near Strathalbyn, and boring was commenced.

SUBSIDIES.

The Legislature provided in the Mining Act, 1893, and in previous measures for the encouragement of mining.

The following schedule shows what subsidies have been paid from the inception of the system to December 31st, 1919, and the sums repaid. In the ordinary way these repayments are made from profits—50 per cent. of such profits being devoted to repayments. In two instances only have the profits won enabled full repayments to be accomplished—the Crystal Mine, at Echunga, which repaid £76 7s.6d. from that source, and the once-famous New Alma and Victoria Mine, Waukaringa, which repaid in full the first subsidy, £3,000. The repayment of £2,100 by the Hamley Company was made on the sale of the property to the Wallaroo and Moonta Co. The remainder of the recoveries was derived from sales of mining plant held as security. The total of the subsidies advanced is £65,108 16s. 1d., of which £11,219 5s. 4d. have been recovered, and £2,250 written off, leaving a debit balance of £51,639 10s. 9d. Portion of this outstanding debt is represented by machinery that has fallen into the hands of the Government; add to this the value of the metals won, and the State in general will probably have benefited beyond the money value of the debit balance.

STATEMENT OF SUBSIDIES PAID FROM COMMENCEMENT TO DECEMBER 31ST, 1919.

Name of Company or Person to whom Subsidy Granted.	Locality.	Amount Advanced.			Amount Repaid.		
		£	s.	d.	£	s.	d.
Adelaide Crushing, Grinding, and Amalgamating Mill Co.	—	100	0	0	—		
Algebuckina Gold Mining Syndicate	Algebuckina	52	10	11	52	10	11
Alma Extended Gold Mining Co.	Waukaringa	3,000	0	0	276	16	0
Backhouse, T. S.	Worturpa	100	0	0	—		
Barossa Enterprise Gold Mining Coy.	Barossa, Hundred of	232	2	6	—		
Belalie Copper Mining Syndicate	Bundaleer	392	12	3	—		
Beltana Rapid Ore Treatment Syndicate	Near Beltana	596	8	4	—		
Bevilaqua & Angel	Palmer (near)	57	18	0	—		
Bird-in-Hand Gold Mining Co., Ltd.	Woodside	3,000	0	0	—		
Blackfellow's Creek Gold Mining Co., Ltd.	Kuitpo, Hundred of	660	6	7	35	0	0
Callington Copper Mining Co.	Callington	148	8	7	17	0	0
Cockburn Copper Mining Co., N.L.	Mutooroo	273	18	5	173	13	8
Commonwealth Silver-lead Co., Ltd. (Wheal Ellen Mine)	Strathalbyn, Hund. of	750	0	0	440	3	3
Copper Hill Mining Co., N.L.	Kadina	391	15	0	115	0	0
Cornwall Copper Mining Syndicate, N.L.	Kadina, Hundred of	500	0	0	—		
Countess of Jersey Gold Mining Co., N.L.	Wadnaminga	321	0	0	—		
Cowell Consolidated Silver and Copper Mines	Hds. Miltalie & Hawker	406	9	8	25	0	0
Currency Creek Copper Mining Co.	Currency Creek	28	6	5	20	0	3
Crystal Gold Mining Co.	Echunga	563	17	6	176	7	6
Davis, A. (Dorris Fabian Mine)	Leigh's Creek, Near	357	0	0	—		
Ding Dong Copper Mining Syndicate	Kanmantoo, Hund. of	124	0	4	—		
Duke of Cornwall Gold Mining Syndicate	Mount Pleasant	458	17	4	43	10	0
Eagle Silver Mining Co, Ltd.	Glen Osmond	500	0	0	—		
Ediacara Consols Silver Mining Co., N.L.	Ediacara	651	12	1	465	17	0
Enterprise Copper Mining Co., N.L.	Barossa, Hundred of	150	0	0	9	16	0
Enterprise Excelsior (Barossa Amalgamated)	"	2,000	0	0	—		
Eureka Gold Mining Co., Ltd.	Woodside	1,500	0	0	—		
Eureka Gold Mining Syndicate	"	340	17	11	—		
Fels, J. A. R. (Nichol's Nob Mine)	Leigh's Creek, Near	150	0	0	—		
Fifth Creek Central Silver and Copper Mining Co., N.L.	Fifth Creek	253	2	4	—		
Fortress Hill Mining Syndicate	Fortress Hill	60	0	0	—		
Foster, A. E. J. (David Copperfield Mine)	Hundred Onkaparinga	19	5	0	—		
Glenloth Mining, Battery, & Options Co., N.L.	Glenloth	515	4	7	515	4	7
Glenloth Wells Pioneer Blocks Co., Ltd.	"	100	0	0	22	18	5
Great Eastern Gold Syndicate, N.L.	Wadnaminga	300	0	0	300	0	0

STATEMENT OF SUBSIDIES PAID—*continued.*

Name of Company or Person to whom Subsidy Granted.	Locality.	Amount Advanced.	Amount Repaid.
		£ s. d.	£ s. d.
Gumeracha Gold Mining Syndicate	Gumeracha	75 0 0	—
Golden Junction Gold Mining Co, N.L.	Hundred of Coglin	231 10 0	—
Golden Point Claims	Wonna	50 0 0	—
Great Ironclad Gold Mining Co.	Teetulpa	218 6 9	—
Hakendorf, C. H., and Williams, J. (Glenmarkie Mine)	Glenloth	221 17 6	12 0 0
Hamley Copper Mining Co.	Wallaroo	2,100 0 0	2,100 0 0
Homeward Bound and Klondyke Gold Mines, N.L.	Mannahill	192 17 1	58 18 6
Heithersay, J. (Kirkeeks Treasure Mine)	Waukaringa	819 3 0	3 19 9
Hunter Bros. (Lady Millicent and Nuccaleena Mines)	Mochatoona	699 19 10	12 0 0
Ireby Gold Mining Syndicate	Mount Grainger	35 4 3	—
Kanappa Copper Mining Co.	Hundred Angas	146 19 11	1 5 0
Kanmantoo Copper Mines Syndicate, N.L.	Kanmantoo	150 2 1	—
Kingsborough, W. A. (Benowrie Mine)	Near Cutana	31 18 6	—
Kirkeek's Treasure Gold Mining Co.	Waukaringa	691 8 1	—
King's Bluff G.M. Co., N.L.	Olary	622 0 8	—
Kohinoor Gold Mining Co., N.L.	Kangaroo Island	100 0 0	—
Kohinoor Mine (H. G. Taylor)	"	200 0 0	—
Lady Alice Gold Mining Co.	Barossa, Hundred of	1,797 2 3	—
Lady Franklin Syndicate	Port Lincoln	200 0 0	40 0 0
Leigh's Creek South Coal Mining Co., N.L.	Leigh's Creek	95 16 4	95 16 4
McMurtie's Claims	Kuitpo, Hundred of	199 19 11	—
Mingary Gold Mining Co.	New Luxemburg	400 0 0	—
Montacute Gold and Copper Mining Co., N.L.	Sixth Creek	400 0 0	—
Mount Victoria Mine	Bimbowrie	50 0 0	—
Mount Malvern Silver Mining Co.	Blackwood	491 3 6	—
Mount Malvern Silver-lead Mining Co., N.L.	Clarendon	1,539 6 4	—
Mount Pangæus Gold Mining Co.	Hahndorf (near)	56 1 4	—
Mount Monster Gold Mining Syndicate	Kuitpo, Hundred of	350 0 0	1 0 0
Mt. Grainger Ironclad Gold Mining Syn., Ltd.	Mount Grainger	21 18 10	—
Mount Torrens Gold Mining Co.	Mount Torrens	1,000 0 0	—
Mount Remarkable Mining Co., Ltd.	Wongyarra, Hund. of	122 8 1	15 0 0
Musgrave Ranges Prospecting Association	Musgrave Ranges	47 2 0	—
Mount Painter Corundum and Gem Syndicate	Mount Painter	47 3 1	—
Morning Star Gold Mining Co.	Teetulpa	68 4 6	—
Mutooroo Copper and Silver Mining Co., Ltd.	Mutooroo	500 0 0	500 0 0
Myrtle Gold Mines, N.L. (Dustholes)	Hd. Coglin	370 1 4	25 0 0
Nackara Proprietary Copper Mining Co., N.L.	Nackara	100 0 0	—
Nackara Proprietary Gold Mining Syndicate.	Nackara	100 0 0	—
New Banksia Gold Mining Syndicate	Nairne	250 0 0	—
New Alma and Victoria Gold Mining Co., Ld.	Waukaringa	3,000 0 0	3,000 0 0
New Ajax Consolidated Gold Mining Co., N.L.	"	750 0 0	—
New Era Gold Mining Co., Ltd.	Woodside	1,000 0 0	—
New Glenloth Battery and Mining Co., N.L.	Glenloth	750 0 0	—
New Medora and Grainger Gold Mines Syn., N.L.	Mount Grainger	1,421 9 9	—
New Mingary Gold Mining Co.	New Luxemburg	250 0 0	—
New Mount Grainger Gold Mines, N.L.	Mount Grainger	393 7 1	220 0 0
Northern Mining and Smelting Co., N.L.	Mount Rose	350 0 0	3 15 0
North Nairne Gold Mining Co.	Nairne	500 0 0	—
North-West and West Australian Pros. Co.	North-west of S.A.	104 9 7	—
North-West Prospecting Association, N.L.	Tarcoola	150 0 0	—
Nil Desperandum Teetulpa Devt. Co., N.L.	Teetulpa	64 14 4	20 5 6
Nilpena Copper Mining Co., Ltd.	Blinman	290 5 3	—
Olivaster Silver-Lead Mining Co., N.L.	Hundred Yankalilla	300 0 0	—
Onkaparinga Dredging and Mining Co., and Echunga Propy. Hydraulic Gold Sluicing Co.	Biggs' Flat	1,050 0 0	700 0 0
Paull's Consolidated Copper Propy., N.L.	Burr Well	525 0 0	16 13 0
Parara Mining Co., N.L.	Maitland	571 3 6	—
Paringa Mining Syndicate	Callington	399 16 8	244 0 0

STATEMENT OF SUBSIDIES PAID—*continued.*

Name of Company or Person to whom Subsidy Granted.	Locality.	Amount Advanced.			Amount Repaid.		
		£	s.	d.	£	s.	d.
Paringa and West Kanmantoo Consolidated Copper Mine, N.L.	Callington	1,144	3	4	210	5	0
Pioneer Gold and Copper Mining Syndicate	"	95	15	6	66	19	6
Polmear, W. J. L. (Poona Mine)	Moonta	800	0	0	31	0	0
Poonana Silver, Lead, & Copper Mining Syn.	Hundred Mann	137	7	10	—		
Port Lincoln Copper Co., Ltd.	Reedy Creek	800	0	0	—		
Prince Albert Mining Syndicate	Hundred Onkaparinga.	214	0	0	2	0	0
Queen Bee Mining Co., N.L.	New Luxemberg	250	0	0	250	0	0
Quorn Manganese and Silver Mining Co.	Quorn	10	9	10	—		
Rapid Bay Silver Mining Co., N.L.	Yankalilla, Hund. of..	136	2	4	—		
Robertstown Bright Silver Lead Mines	Hd. Bright	170	5	11	—		
Royal Charlie Gold Mining Co.	Mannahill	153	18	5	—		
Rees, R. (Ajax Mine)	Waukaringa	604	14	5	—		
Saunders, L. E. (Great Eastern Mine)	Wadnaminga	98	10	0	98	10	0
Sixth Creek Gold & Copper Mining Co., L.N.	Sixth Creek	161	1	11	—		
Stainbank, A. T.	Fifth Creek	70	14	11	—		
Sliding Rock Copper Proprietary, N.L.	Sliding Rock	2,000	0	0	32	11	0
Tarcoola Blocks Gold Mining Co., Ltd.	Tarcoola	4,345	5	2	214	10	5
Tarcoola Enterprise Gold Mining Co., N.L.	"	100	0	0	19	10	4
Tarcoola Proprietary Gold Mines, N.L.	Tarcoola	150	4	4	9	15	0
Teatree Gully Gold Mining and Pros. Assn.	Teatree Gully	234	5	7	—		
Teetulpa Mining and Crushing Co.	Teetulpa	349	11	4	—		
Teetulpa Prospecting Syndicate	"	49	15	6	—		
Trewartha S.H. (Royal George Mine)	Tarcoola	10	0	0	—		
Tumby Bay Copper Mining Co., N.L.	Hutchison, Hund. of..	800	0	0	—		
Uley Graphite Syndicate	Uley, Hundred of	210	15	0	—		
Utica Copper Mining Co. N.L.	Burra	224	16	7	109	18	6
Victoria Hill Amalgamated Gold Mining Syn.	Barossa, Hundred of ..	38	12	6	—		
Victoria Tower Mining Co., N.L.	Mannahill	345	18	9	90	0	0
Walton Hill Copper Mining Syndicate	Near Freeling	50	0	0	1	10	0
Warrakimbo Propy. Copper Mining Synd.	Barndioota, Hundred of	220	16	2	—		
Warra Warra Propy. Copper Mines, N.L.	Farina	322	4	11	322	4	11
Watt's Gully Gold Mining Co.	Gumeracha	50	0	0	—		
Watt's Gully Reef Claims	Gumeracha	50	0	0	—		
Wolters, F. C., & Co	Echunga	25	0	0	—		
Wallaroo Central Mining Co., N.L.	Kadina	500	0	0	—		
Westward Ho Mine (Dr. H. Dixon)	Mannahill	1,000	0	0	—		
Wohler, H., & Co.	Myponga	20	0	0	—		
Wheal Turner Copper Mining Co., Ltd.	Prospecting on proposed line to Queensl'd Border	1,000	0	0	—		
Winninninnie Gold & Silver Propy. Co., N.L.	Winninninnie	86	3	6	—		
Woodside Boring and Mining Syndicate	Woodside	422	17	11	—		
Worturpa Exploration and Mining Co., Ltd.	Worturpa	800	0	0	—		
Yelta New Copper Mining Co., N.L.	Wallaroo	1,000	0	0	—		
Young Bullfinch Gold Mining Co., N.L.	Talunga, Hundred of	146	3	4	2	0	0
Totals	—	65,108	16	1	11,219	5	4

NOTES ON THE SAMPLING AND VALUATION OF PROSPECTS.

The Department of Mines, Flinders Street, Adelaide, frequently receives for assay and advice, parcels of various minerals and ores. Such a parcel may have one or more of the following faults:—

(1) It may contain a single piece, obviously picked.

(2) The quantity forwarded may be of insufficient size either for assay purposes or to properly represent the material sampled.

(3) The parcel may be unaccompanied by any statement or request showing the information desired.

(4) It may carry no marks to identify it with the letter of advice.

(5) There may be no letter of advice.

(6) There may be no declaration of the exact locality, without which free assays cannot be made.

(7) The letter of advice may contain no information as to the width or size of the body from which the material has been taken—information which may be necessary before it is possible to advise as to the value of a deposit.

THE MEANING OF THE WORD "SAMPLE."

A specimen is not a sample. A specimen shows the nature of a rock or ore; a sample is intended to show its value, and must be representative of a pile of ore or of a lode at a definite place.

A "representative" sample is a small proportion of the original bulk, containing, in unchanged percentages, all the constituents of the original lot. Such a sample gives the value of a pile of ore. The average of a number of samples, broken from the workings of a mine, represents very closely the value of the material sampled. Both broken ore and mines are, in many cases, sold on the values arrived at by sampling.

HOW TO TAKE A SAMPLE.

In sampling a lode, samples should be taken at definite intervals, and the lode should be sampled over measured widths at these localities. Widths should be measured at right angles to the lode, that is, along the shortest line between the walls.

A sample must be taken by breaking the same bulk for each foot of width. This should be done as evenly as possible over the whole width that the sample is intended to represent, and all the material that would be subsequently milled or smelted, whether rich or poor, should be included in the sample. The quantity taken might amount to one pound per foot of lode width; but the nature of the ore body and the distribution of the values (whether uniform or irregular) must be considered when deciding on the size of the sample. With uniform values the interval along the lode can be greater and the amount broken less than if the lode carries irregular values, as in the case of a lode carrying coarse gold.

THE PROPER WAY TO REDUCE THE SIZE OF A SAMPLE.

Such a sample, if of any considerable size, should then be broken into smaller pieces, well mixed, and quartered down. Quartering down means that the broken ore, after mixing, is piled into a cone on a floor or cloth, and that the cone is flattened and subdivided into four parts by two cuts at right angles. If the ore is sufficiently broken and mixed the sample obtained by taking the two opposite quarters, A A, has a value equal to the rejections B B, shown in the following diagram:—

HOW A SAMPLE SHOULD BE QUARTERED.

At each quartering care should be taken to sweep all rejections away.

By successive finer crushing and quartering, a sample, of 1lb. to 2lbs. is obtained that has the same value as the bulk first broken from the lode. This sample of 1lb. to 2lbs. should then be properly bagged, marked, and sent for assay. It would be well to enclose a specimen of 1oz. to 2ozs. of the uncrushed ore for inspection.

In reducing the large sample first obtained it is essential that the lumps of ore be broken smaller by at least half between each quartering. For example, a sample averaging, as broken, 1in. pieces, might be broken to $\frac{1}{2}$in., $\frac{1}{4}$in., and $\frac{1}{8}$in. particles before each successive quartering, to ensure uniform mixing and the even distribution of the valuable material.

THE USE OF ASSAY RESULTS.

Individual samples of standing ore may differ from the true value of the lode, but the average of a number of such samples will be very nearly that of the body of stone which they represent. Thus it will be seen that, in estimating the value of standing ore, reliance is to be placed, not on a single sample, but on the average value of a number of samples.

THE VALUATION OF BROKEN ORE.

Sampling a pile of broken ore may be done either by quartering, or by taking every second, tenth, or any other proportion of shovelfuls when shovelling the pile over, the proportion depending upon the way in which the values are distributed through the ore.

In sinking or driving on a lode, the value of the ore broken can be determined by making a separate pile with every fifth or tenth bucket of ore raised, and cutting down the small pile so made by shovelling and quartering. This procedure, if adopted, would in many cases prevent undue disappointment or the incurring of a loss through sending unpayable material to be treated.

ESTIMATION OF GOLD CONTENTS BY PANNING.

In estimating gold contents by panning during prospecting work, representative samples of constant weight or bulk should be taken. Too often a selected lump of kindly appearance is crushed, with the result that the value of the ore is over-estimated, and disappointment results when a parcel is sent to a battery. A record kept of all panning results, and the position and width of lode over which a sample is taken, will do much towards facilitating the opening up of a mineral property.

SUGGESTIONS FOR TAKING AND FORWARDING SAMPLES.

It is suggested that the following precautions be taken in sending samples for assay:—

(1) Each sample should be taken so as to be representative of the material sampled.

(2) Each sample should be properly marked so that it can be identified by the Department and by the sender.

(3) A letter of advice referring to these marks should be sent containing particulars as to—

(*a*) The exact location of the material sampled relatively to some well-known point.

(*b*) The width over which the sample has been taken.

(*c*) The depth at which it was taken.

(*d*) What valuable constituent is supposed to be present.

The Department reserves the right to refuse to make any particular assay of samples of insufficient promise or which do not conform to the conditions enumerated above.

No assays will be made of metallurgical products, and no umpire samples or materials showing free gold will be tested.

ACCIDENTS IN MINES AND QUARRIES.

A gratifying feature of our mining operations in mines and quarries is the infrequency of serious accidents. Act No. 858 of 1904, bringing quarries in the same category as mines as regards the control of the Department of Mines has been effective in safeguarding the interests of quarry-men. The following table gives the number of accidents in mines and quarries during the last ten years:—

ACCIDENTS IN MINES AND QUARRIES.

Accidents in Mines.				Accidents in Quarries.			
Year.	Total Number of Accidents Reported.	Number of Persons Injured.	Number of Persons Killed.	Year.	Total Number of Accidents Reported.	Number of Persons Injured.	Number of Persons Killed.
1910	6	3	3	1910	2	1	1
1911	2	—	2	1911	—	—	—
1912	3	2	1	1912	2	—	2
1913	10	8	2	1913	—	—	—
1914	3	2	1	1914	3	2	1
1915	3	—	3	1915	3	2	1
1916	5	1	4	1916	—	—	—
1917	8	6	2	1917	2	2	—
1918	7	5	2	1918	2	2	—
1919	—	—	—	1919	3	2	1

ASSAYS AT SCHOOL OF MINES.

NUMBER OF ASSAYS MADE FOR PUBLIC PURPOSES AT THE SCHOOL OF MINES ASSAY DEPARTMENT DURING THE SIX MONTHS ENDED DECEMBER 31st, 1919.

	1919.					
	July.	August.	September.	October.	November.	December.
Department of Mines	74	129	98	139	188	104
Public assays	60	45	53	43	28	32
Totals	134	174	151	182	216	136

REPORTS FORMING ADDENDA TO THE RECORD OF MINES.

Second Summary Report on the Utilization of Leigh Creek Coal by the Leigh Creek Coal Committee.

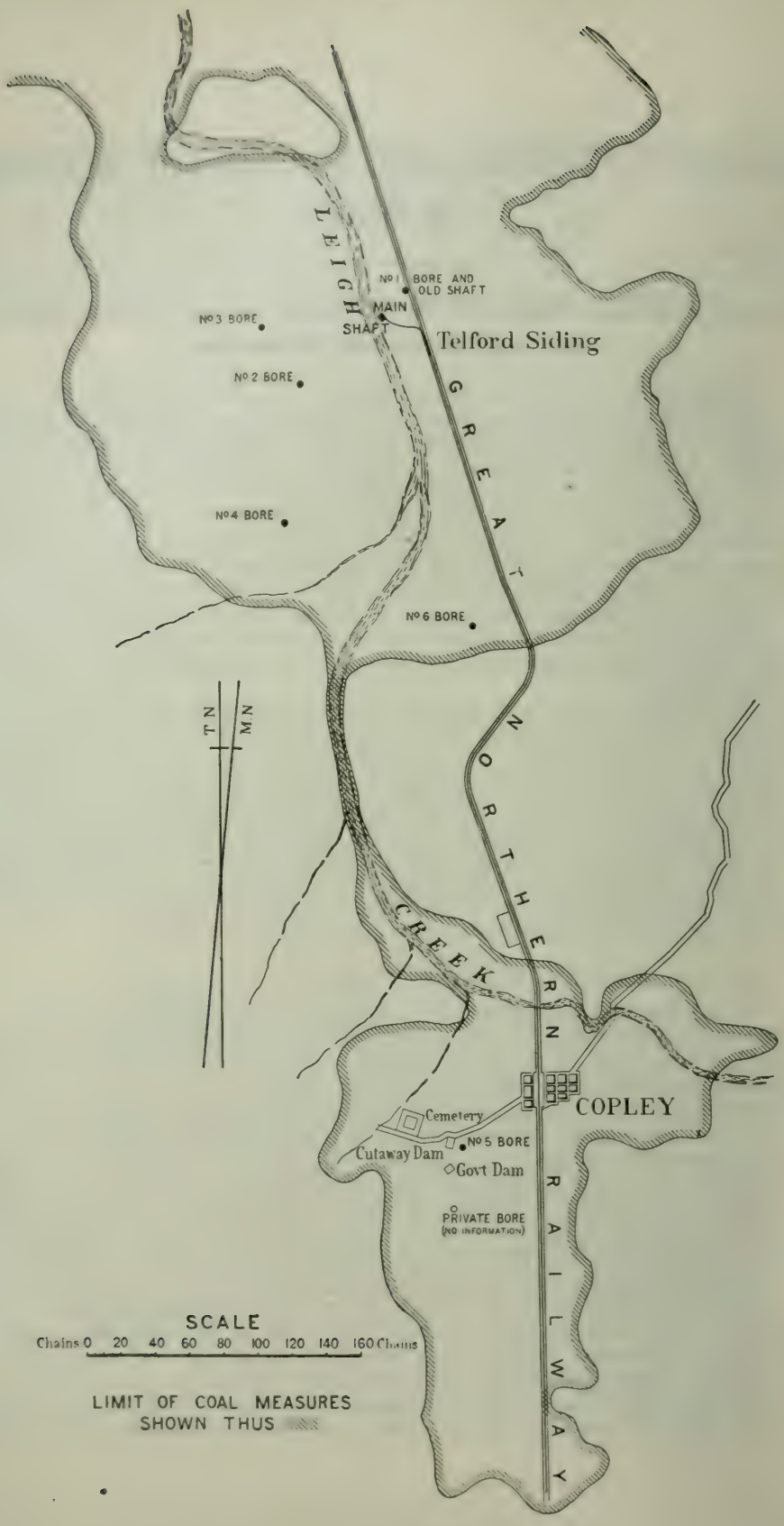
During the period that has elapsed since its creation in January, 1917, the Leigh Creek Coal Committee has given consideration to very many aspects of the problem of making profitable use of the reserves of fuel at Leigh Creek. In the course of these investigations a constant endeavor has been made to keep a close control of all experimental work by means of measurements and analyses, without which no reliable results are obtainable. Many proposals have been placed before the Committee, many tests have been performed under its supervision and control, and many lines of investigation have been pursued independently by members of the Committee. The mass of information that has been thus gathered together has been of great value in building up a sure foundation on which recommendations may be based, and in furnishing the means of testing the value of proposals for the utilization of the coal.

The Committee desires to place on record its grateful appreciation of the generous action of those companies which permitted the performance of controlled tests, some of which were carried out at a time when the shortage of fuel was acute and when every effort was being maintained to prevent the diminution of production. The general attitude of consumers of fuel in this State towards the experimental work has been such that the Committee has felt that its inquiries have not been prosecuted in vain, and that the pains that have been taken to investigate the economic aspects of the many problems raised have been spent in the effort to arrive at the solution of one of the controlling factors of South Australian industrial welfare.

THE DEVELOPMENT OF THE COALFIELD.

No coal has been raised from the colliery at Leigh Creek since the Committee presented its last report (P.P. 74 of 1918) in August, 1918; but good use has been made of the coal previously raised, and a limited quantity remains available for further experimental work.

A drilling plant has been at work for some considerable time on the coalfield, and the results obtained from the bore holes have given particulars with regard to previously unexplored portions of the basins filled with coal measures. Borehole No. 5, near Copley township, was recently drilled, and bedrock was reached at a depth of 677ft. without the discovery of any appreciable seam of coal. The shales penetrated were carbonaceous throughout, but the best defined seam or lens of coal in the core recovered by drilling was only 1in. thick. These results gave no encouragement towards further exploratory boring in the more southerly of the two basins occupied by the coal measures, and the drill was moved to a site in the southern portion of the northerly basin. At this place borehole No. 6 was drilled, and has given a complete section of the coal measures above bedrock, that was reached at 912ft. from the surface. The main seam was entered at 711ft., and proved to be 21ft. 6in. thick, including a shaly band 1ft. in thickness in the body


LEIGH
No 1 BORE AND OLD SHAFT
MAIN SHAFT
Telford Siding
No 3 BORE
No 2 BORE
No 4 BORE
No 6 BORE
GREAT NORTHERN
TN
MN
CREEK
COPLEY
Cemetery
No 5 BORE
Cutaway Dam
Govt Dam
PRIVATE BORE
(NO INFORMATION)
RAILWAY
SCALE
Chains 0 20 40 60 80 100 120 140 160 Chains
LIMIT OF COAL MEASURES
SHOWN THUS

of the coal. Another seam, 3ft. in thickness, was entered at 882ft. 6in. The position of all the boreholes with regard to the boundaries of the field and the railway is shown on the accompanying plan.

The coal obtained from the main seam by drilling has been analysed and found to be similar in general character to that obtained from the colliery and the bores to the northward. The chief point of difference between the main seam at the site of No. 6 borehole, and the more northerly portions of the seam concerns the distribution of the incombustible mineral matter in the seam. In the area previously explored the cleanest coal lies at the top of the seam, whereas in No. 6 borehole the best consecutive samples over a thickness of 6ft. are centrally situated in the seam. In other respects the coal obtained from the last borehole is similar in character to that obtained in other explored parts of the field. The general features exhibited by the coal are constant throughout the area tested, and samples have now been obtained from very different depths, namely:—From 125ft. in No. 1 bore, from 240ft. in the main colliery workings, from 608ft. in No. 3 bore, from 711ft. in No. 6 bore, and from 1,496ft. in No. 2 bore.

The following table shows the range of composition over the whole thickness of the main seam where cut by No. 6 bore, and also the average composition of the seam.

	As Raised.			Air Dried.		
	Max.	Min.	Average.	Max.	Min.	Average.
Moisture at 105° C.....	29·22	15·50	20·00	22·64	11·88	15·96
Volatile matter	32·78	20·63	25·50	34·44	22·28	27·38
Fixed carbon	42·90	29·66	36·40	45·35	31·16	37·65
Ash	32·77	3·95	18·08	34·68	5·27	18·99
Sulphur	—	—	—	0·24	0·04	0·11

While, therefore, recent boring operations have indicated that the more southerly of the two basins filled with coal measures does not carry any workable seams of coal, as far as is yet known, the more northerly basin has been found to carry a thick seam far beyond the limits of the area previously tested.

INVESTIGATIONS OF METHODS OF UTILIZATION.

The following brief review of the experimental work and tests that have been carried out on the Leigh Creek coal comprises a summary of the results that have been under the consideration of the Committee:—

(*a*) When used for raising steam in stationary boilers, the results obtained by the use of Leigh Creek coal alone are not satisfactory, unless special consideration is given to the design of the firebox and mechanical feeder. Many different types of boilers have been tested and the results show that an evaporative power of 5lbs. of water per lb. of the coal can be confidently expected in a well-designed plant.

Tests carried out in August, 1918, during a period when fuel from New South Wales was scarce, with mixtures of Leigh Creek coal and Newcastle coal, at the British Broken Hill Proprietary Mine, Broken Hill, showed that good results were obtained when 2 parts of Newcastle coal were mixed with 1 part of Leigh Creek coal. This test was performed on chain grate stokers with Babcock & Wilcox boilers. Attempts to use the Leigh Creek coal alone under similar conditions proved unsuccessful. In the consideration of a possible use for the coal in such plants, it has been quite

clear that the coal cannot be supplied at the large centres of fuel consumption at a price that will compare favorably with that now ruling for coal from New South Wales, when due allowance is made for the calorific values of the two coals.

(*b*) The tests that have been made of Leigh Creek coal in gas producers indicate that power can be successfully generated in this way. The relative value of the coal has been established by actual tests as 1¾ tons of Leigh Creek coal to 1 ton of Newcastle coal when thus used. If any large demand for power should arise at the mine, it is beyond doubt that the best method of utilizing the coal would be in producers. The cost, however, of coal delivered at localities where power is now in large demand precludes its economic use at the present time.

(*c*) The Committee has been generously assisted by Mr. P. Motteram, B.E., in the investigation of the possibility of generating electricity at Leigh Creek and transmitting it as far as Adelaide. The conclusions arrived at are not favorable to the suggestion, since electrical energy can be more cheaply generated from imported fuel at any port on the South Australian coast.

(*d*) The results of the tests on Leigh Creek coal in railway locomotives were described in the Committee's first report (P.P. 74 of 1918). The objections are the difficulties concerned with the handling of the clinker, the complete disintegration of the coal, and the emission of sparks in spite of efforts to arrest them. Even when two parts of Newcastle coal were used to every part of Leigh Creek coal, difficulty was experienced in maintaining enough steam to surmount steep grades. The objections to the use of the coal in the ordinary way in locomotives do not appear likely to be overcome by any modification in locomotive boiler design.

(*e*) The behavior of Leigh Creek coal when subjected to distillation is not conducive to a hopeful outlook for its profitable use in this way. The gases generated when it is treated in a retort are relatively small in amount. Their composition is more nearly akin to that of the gases produced by the destructive distillation of wood than to those obtained by retorting ordinary bituminous coal, and their calorific value is low. Only a small percentage of tar is obtained from this method of treating Leigh Creek coal. The residue after distillation is high in incombustible matter.

The following table shows the composition and calorific value of the gas obtained from Leigh Creek coal, of the gas distilled from eucalyptus wood, and of ordinary coal gas:—

	Gas from Leigh Creek Coal.	Gas from Eucalyptus Wood.	Average Coal Gas.
	Percentage by Volume.		
Carbon dioxide, CO_2	20·3	19·4	0·5
Heavy hydrocarbons, C_2H_4, &c.	1·1	2·6	5·3
Oxygen, O	1·7	0·3	0·3
Carbon monoxide, CO	23·3	27·8	10·0
Hydrogen, H	34·4	27·0	45·0
Marsh gas, CH_4	17·1	15·9	33·0
Nitrogen, N	2·1	7·0	5·9
B.T.U. per cubic foot, at 60° F. and 1 atmosphere..	351	364	575

The first two columns refer to analyses made in the Department of Chemistry, Adelaide.

While no exhaustive testing of the Leigh Creek coal has yet been performed in a plant designed to carry out low-temperature carbonisation, the application of those methods has been considered, and the Committee has discussed the matter with Sir Douglas Mawson, who has investigated recent European practice along these lines. It is felt that the chances of success of low-temperature distillation are handicapped by the nature of the residual products with their high content of ash. This difficulty is not to be readily surmounted, as the Leigh Creek coal is not easily freed from the non-combustible mineral matter. There is, moreover, an obstacle to washing the coal in the difficulty of providing adequate quantities of water in an arid region. The residue after distillation cannot, therefore, stand comparison with the residue remaining when fuel with a low content of ash is submitted to low-temperature distillation, with the subsequent briquetting of the non-volatile material.

It is also manifest that the distillation products must needs be transported to markets if distillation is effected at the colliery.

The Committee is of the opinion that further experimentation along these lines should be temporarily postponed until an investigation has been made in other directions that give greater promise of useful results.

(*f*) The briquetting of Leigh Creek coal can be successfully achieved if no regard be paid to the economic aspects of the process. Members of the Committee have prepared excellent briquettes with the use of pitch as a binder. But the cost of materials in such briquettes precludes their successful competition with imported coal, when reliance is placed on the use of pitch prepared from other coal. In a small experimental plant Leigh Creek coal itself was found to contain so little tar that 5 tons or more would be required to provide the binder necessary to make 1 ton of good briquettes. The general experience in other countries is that no other binder is as satisfactory as coal-tar pitch, which is almost invariably used wherever briquettes are manufactured. It is obvious that the Leigh Creek field is remote from places where coal-tar pitch is produced, and that transport charges have to be taken into account. Many proposals have been made to the Committee with regard to briquetting, and some of these have been beyond the reach of investigation through the lack of data as to the nature and quantities of the materials to be used. The function of the Committee in such cases is that of investigation, and it is not possible to decide upon the probability or improbability of the success of a process, the essential details of which are withheld. Although the Committee had no wish to unveil secret methods, it found itself in some cases unable to give consideration to proposals which were not supported by sufficiently definite facts and figures.

Those who have any data worthy of consideration from the commercial aspect will at least have retained a record of the quantities of the materials used by them in their experiments, and the Government is entitled to demand full information as to quantities where State aid is sought for carrying out large scale experiments or for erecting a working plant.

It is essential that basal figures relating to the cost of the raw coal, the cost of the binder at Leigh Creek, the cost of manufacture, the cost of transport of the finished briquettes, and the calorific value of the briquettes be taken into consideration when proposals are made to displace imported coal by briquetted coal from Leigh Creek. Some of the data required for this purpose will be found in a later part of this report.

If a cheap method of briquetting could be devised there would be an undoubted demand for the briquettes for locomotive use on the Northern railway, but it does not seem probable that briquettes could be conveyed profitably to centres where a large demand exists for them as industrial and domestic fuel.

(*g*) In view of the rapid development in all parts of the world in the application of pulverised fuel in stationary and locomotive boilers, the possibility of using Leigh Creek coal in this form has received special consideration. Early tests were not satisfactory through the absence of the proper means of reducing the coal to the extremely fine state of division that has been found by experience to be necessary for success. When, however, the coal was sufficiently finely ground, the results obtained gave promise of success. One sample of the coal was submitted to an American firm, which reported that the coal was suitable for use in the pulverised state, provided that proper precautions are taken for eliminating moisture and for grinding the coal to the proper degree of fineness. A test was made on a large scale by courtesy of the Adelaide Cement Company, Limited, at their works at Birkenhead. Certain difficulties, inherent in the attempt to use a plant designed for pulverising and drying Newcastle coal, were experienced; but for 11 hours the kiln was operated continuously with good results. The report stated that from two to two and a quarter times as much Leigh Creek coal would be required to produce the effect of 1 ton of medium-quality Newcastle slack coal; but the Committee is of the opinion that with a plant designed specially to use Leigh Creek coal, the quantity of this coal would have been from one and a third to one and a half times as much as of Newcastle coal.

The Committee is satisfied that the possibilities of using Leigh Creek coal successfully in this form are so promising that a plant should be installed to pulverise the coal, and that a locomotive engine and tender should be adapted for burning powdered coal, in order that an extended series of trials may be made on the Northern railway. It is thought that the plant should be erected at Leigh Creek, where climatic conditions are most favorable, so that the tests may be carried out close to the place of production of the coal. This proposal would cause less interference with the normal working of the railway than any other that could be suggested; and there are centres both to the north and to the south of the mine to which loads can be carried under normal working conditions. It is greatly to be desired that the conditions, under which tests are carried out, be those which represent the ordinary conditions governing normal traffic on the Northern railway. These governing conditions include climatic influences, for Leigh Creek coal is adversely affected by moist air, and it is certain that trials carried out in the region in which the mine is situated will be not only more likely to succeed, but also more nearly adjusted to actual working conditions than tests from any more southerly centre.

GEOGRAPHICAL CONTROL OF COMMERCIAL AVAILABILITY.

It will be seen from the above summarized discussion of the various proposed methods of use for Leigh Creek coal that the geographical position of the field controls every suggestion that has been made. The outstanding fact is that the colliery is 169 miles distant by rail from the nearest seaport —Port Augusta. It is 225 miles distant from Peterborough, 298 miles from Port Pirie, 350 miles from Wallaroo, 377 miles from Port Adelaide, and 370 miles from Cockburn, all measurements being by the most direct railway routes.

The only local demand for the coal that is appreciable is that for use in railway locomotives. This demand amounts to 4,500 tons of Newcastle coal per annum for the Northern railway system, and a larger tonnage of Leigh Creek coal would be required to perform the same amount of work.

Any extension of the railway system to the northward will increase this demand, and the colliery is, of course, advantageously situated for furnishing fuel supplies to the Northern line. The coal which can be produced at a point 169 miles from the nearest port at which sea-borne coal can be delivered is well placed if it can be used effectively and in sufficient quantities to make the mining profitable.

The situation of the coalfield in an arid region will undoubtedly affect the cost of mining adversely. The problem of providing a satisfactory water supply for mining and domestic purposes will not be easily nor cheaply solved. And it is anticipated that the cost of mining the coal will not be less than 12s. 6d. per ton at the mouth of the shaft.

In formulating this estimate of minimum cost, consideration has been given to the cost of mining when the colliery was last worked, the subsequent changes in the normal wage rate, the cost of mining coal elsewhere in Australia at the present time, and general industrial conditions throughout the world.

CONCLUSIONS AND RECOMMENDATIONS.

After giving full consideration to all the facts and figures summarised in the earlier part of this report, the Committee has made a more detailed investigation of the most promising scheme for the utilization of Leigh Creek coal—that concerned with its use in the powdered form in locomotives on the Northern railway line as suggested by Mr. J. P. Burnside, Chief Inspector of Steam Boilers. In this investigation no little assistance has been afforded by the special report on "Pulverised Coal Systems in America," prepared by Leonard C. Harvey, and issued by the Department of Scientific and Industrial Research in Great Britain during 1919.

From this report, and from the articles appearing in the proceedings of engineering institutions and in the columns of the technical press, the following conclusions have been drawn:—

(*a*) The use of pulverised coal in locomotive engines is rapidly expanding, especially in those regions where inferior coals are the only varieties avavilable.

(*b*) The efficiency of low-grade coals when used in the powdered form is very much greater than the efficiency of the same coal in lump form. This increased efficiency is found to be at least 25 per cent. through the reduction of the heat losses during combustion, and it may be as much as 40 per cent.

(*c*) Coals containing relatively high percentages of ash are best used in powdered form, and the labor of stoking and cleaning is practically dispensed with. Sparking dangers are removed and losses of fuel carried in open tenders are no longer possible.

For the purpose of comparing Leigh Creek coal in powdered form with Newcastle lump coal, which is used in present practice, the following figures relating to prices and costs are furnished:—

The cost of Leigh Creek coal at the surface is taken at 12s. 6d. per ton. When 25 per cent. of moisture has been eliminated the cost per ton of dried

coal is 16s. 8d. per ton. The actual cost of pulverising, according to the figures quoted in Mr. L. C. Harvey's report, in a plant of 20 tons daily capacity, is 3s. 2d. per ton, and to this cost 4s. 8d. per ton must be added to cover interest on the plant and depreciation. The total cost of the pulverised Leigh Creek coal is therefore 24s. 6d. per ton in bins at Telford Siding.

When allowance is made for the use of Leigh Creek coal in powdered form, with an increased efficiency of no more than 20 per cent., there will be required only 1 ton 2cwts. of pulverised Leigh Creek coal to perform the same amount of work as 1 ton of lump coal from New South Wales.

Therefore, 4,950 tons of pulverised Leigh Creek coal when used on the Northern railway line will perform the work of the 4,500 tons of lump coal from New South Wales annually consumed on this system. The latter coal at the present time costs 32s. 9d. in trucks on wharf at Port Augusta, and approximately 34s. on the locomotive loading stage at Port Augusta. The following figures for the annual cost of the coal will be seen to be largely in favor of the Leigh Creek fuel, even without taking into account the cost of freight on the imported coal to loading stages on the Northern railway.

	£
4,950 tons of pulverised Leigh Creek coal, at 24s. 6d.	6,064
4,500 tons of lump Newcastle coal, at 34s.	7,650
Annual saving effected by using pulverised Leigh Creek coal	£1,586

This net saving will be in reality much larger as the production of the coal in South Australia will benefit the State indirectly, and will be the means of retaining in South Australia a large sum paid away annually for coal that is now imported. The margin of profit will be larger if the consumption on the Northern railway increases, and also if the price of imported coal is raised.

The Committee therefore recommends that action be taken as soon as possible to test the conclusions arrived at by full experiments on a working scale and under the normal conditions of traffic on the Northern railway system. In order that these tests may be performed it will not be necessary to make important additions to the equipment on the mine.

The Committee strongly recommends that the erection of a small pulverising plant, having an hourly capacity of 1,000lbs. to 1,200lbs., be entrusted to a company that has had experience in the installation of such plants for dealing with coal of this type, and that the alteration of a locomotive engine and tender be supervised by the same firm. It would be of advantage, in the Committee's opinion, for a representative of the company to supervise all constructional work, and to remain in South Australia until the pulverising plant is in working order, and the tests on the railway locomotives are in progress.

The total expenditure on plant and materials, and the work of erection, construction, and supervision, and the actual tests is estimated to be approximately £5,000.

It is not anticipated that the best results obtainable from Leigh Creek coal in pulverised form will be accomplished without careful testing and trial; but the promise afforded by the experience of other countries is so great that South Australia cannot neglect the possibilities of attaining success with Leigh Creek coal.

At the outset it is suggested that the expenditure be restricted to the sum that is necessary to carry out experimental work only, and that the plant to be erected for this purpose be regarded, so far as is possible, as a unit of a larger installation for pulverising the coal if the experimental work proves successful.

To this report are attached appendices comprising reports on tests of the Leigh Creek coal in the pulverised state, and the suggestions of the Chief Inspector of Steam Boilers for the testing of the coal in locomotive engines on the Northern railway.

R. W. CHAPMAN, Chairman of the Leigh Creek Coal Committee.

November 20th, 1919.

APPENDIX A.

Adelaide Cement Company, Limited, Birkenhead,
February 18th, 1919.

F. Ward, Esq., Secretary, Leigh Creek Coal Committee, Department of Mines.

Dear Sir—We have made two experimental burnings of Leigh Creek coal supplied by you, the consignments received being 5 tons and 60 tons respectively.

The coal was prepared first by passing through an externally heated rotary dryer, and then pulverised in a combination ball tube mill to a fineness giving a residue of 3.5 per cent. to 4 per cent. on a standard mesh screen of 10,000 per sq. in.

The coal dust was conveyed to the rotary kiln bin, from where extracting screws delivered it into the blast pipe for firing.

The rotary kiln used is a revolving cylinder, 125ft. long by 8ft. diameter, and has a capacity under normal conditions of burning 3½ tons to 4 tons of cement clinker per hour.

The first burning on January 15th was made with 5 tons. The pulverised coal was blown into the already heated kiln, following on after Newcastle slack without break in the operation. No difficulty was experienced in maintaining the temperature of approximately 1,450deg. C., and the normal output of clinker resulted.

The second burning, beginning on February 3rd, was made with 60 tons, and operations continued as in the first case. Good results were obtained during the first 11 hours' run, when trouble was experienced through the coal dust sweating in the bin, causing it to clog in the feeder pipes. Owing to this break in operations, the kiln became cold, and in resuming operations it was found that the coal was very slow in raising the temperature again.

Samples of the pulverised coal contained from 15 per cent. to 16 per cent. of water after passing through the drier, although coming from the drier it was hot and appeared dry. I conclude from this that our drier is not suitable, as the temperature attained is not sufficiently high or prolonged.

Much better results could be expected if all the combined water were eliminated.

Used in the conditions stated, the calorific value of Leigh Creek coal as compared to medium-quality Newcastle slack we ascertained as from 2.0 to 2.25 to 1. In estimating the money value for our purpose, consideration would require to be given to the cost of handling, drying, and grinding the increased quantity owing to its lower calorific value.

Two average samples of the ground coal were taken during operations and enclosed in airtight bottles. These we are forwarding to you.

Yours faithfully,

PAUL EVANS, Manager.

Two samples of coal from the 60-ton parcel were analysed with the following results:—

	No. 1. Per cent.	No. 2. Per cent.
Water at 100deg. C.	16.57	16.01
Water above 100deg. C.	2.81	2.61
Volatile matter	25.60	26.37
Fixed carbon	37.99	38.24
Ash	17.03	16.77
	100.00	100.00
Sulphur	0.32	0.23

APPENDIX B.

Department of Mines, Flinders Street, Adelaide, January 29th, 1919.

REPORT ON A TEST OF LEIGH CREEK COAL USED IN FIRING A CEMENT KILN.

Through the courtesy of the Adelaide Cement Company, Limited, a parcel of 5 tons of coal was tested in the large clinkering kiln at Birkenhead on January 15th, 1919.

Outline of Plant Used.

(*a*) *Crushing Mill.*—The coal is raised from the feed flood by elevator to a bin, and thence passed through a rotary drier, where it is thoroughly dried. It is then elevated to a second bin feeding a tube or pebble mill, in which it is reduced to powder. The powder is then conveyed 150ft. to 200ft. to a bin feeding the furnace.

(*b*) *Clinkering Kiln.*—The kiln, which is lined with firebrick, is 125ft. long by 8ft. diameter, and is electrically rotated. Provision is made for five speeds, and these are constantly in use as the requirements of the kiln demand. The powdered coal is fed from the kiln storage bin by screw conveyors into a blast pipe. The screw conveyors can be adjusted to different speeds by means of double-cone pulleys, and the speed is adjusted to the requirements of the kiln. A fan forces air, slightly preheated by the hot clinker, into the blast pipe, about 8in. to 9in. in diameter, where it picks up the powdered coal from the screw feed and forces it into the kiln. The draft may be regulated by a damper in the suction of the fan.

It was noted, before the test began, that the smoke from the kiln when using Newcastle coal was white, and free from any evidence of unburned smoke, except in one case when an excess of coal was fed for a few minutes.

As may be understood, when the need of keeping the supply of Newcastle coal running up to the moment of introducing the Leigh Creek coal and the nature of the apparatus through which the latter had to come is considered the line of demarcation between the two coals was indistinct. There is a difference, though slight, in the appearance of the powdered coals, but with the inevitable mixing in the tube mill, the change from one coal to the other was somewhat indeterminate. At 1.40 p.m., when the test was assumed to begin, it was Leigh Creek powder that was entering the kiln. Some of the 5 tons had probably been used before this, more or less mixed with Newcastle.

Again at the end of the crushing a proportion of Leigh Creek coal was left in the tube mill, and though an attempt was made to displace this with

Newcastle coal, it cannot be said that the whole of the Leigh Creek coal was removed. When the bulk of it had been so removed the tube mill was stopped and the conveyors emptied into the furnace feed-bin.

It will thus be seen that the errors of starting and ending a test, on a plant which must be worked uninterruptedly, are considerable, and with a parcel of only 5 tons, a quantitative estimate of the amount of coal used per ton is practically valueless. The initial and finishing errors, if spread over a considerable tonnage of coal, would, however, be negligible, and such a test would afford a reasonably accurate comparison of value.

Leigh Creek coal was burned between 1.40 p.m. and 3.30 p.m., or 1 hour 50 minutes. Both the rate of revolutions of the kiln and the rate of feed of coal dust were varied constantly, but as far as could be gathered, the kiln maintained its average rate of revolution and its average output. The average rate of fuel fed was considerably greater than when Newcastle coal is in use. The clinker produced throughout from a 75 per cent. calcium carbonate mixture was absolutely satisfactory, and the smoke stack showed practically complete absence of unconsumed smoke, only the faintest tinge of grey or brown being visible.

The coal ignited well, the blast attaining complete incandescence at 5ft. to 6ft. from the nozzle of the pipe, or about the same distance as in the case of Newcastle, and the kiln was as hot at the end as at the beginning of the run. The flame produced was long. The normal consumption of Newcastle coal in the kiln is about 1.1 tons per hour, equivalent to 2 tons for the run of 1 hour and 50 minutes.

Five tons of coal were supplied, but it is probable that considerably less was used during the test owing to losses indicated above. The average moisture of air-dried coal such as was supplied is 11 per cent., and this would reduce the 5 tons to 4.45 tons. It is probable that not more than 4 tons of dust were burned during the period of test, and probably somewhat less. This would give a ratio of 2 tons of Leigh Creek dust to one of Newcastle. The average rate of feed was certainly 50 per cent. in excess of that in use with Newcastle, so that the ratio is probably between 1.5 and 2 to 1 of Newcastle. Only a test on a sufficiently large scale to eliminate the terminal errors can give a true quantitative value.

No difficulty was experienced in pulverising the coal. The powder gave the following results in a screening test:—

	Per cent.
Retained on 20 mesh sieve	0.2
" " 30 " "	0.3
" " 40 " "	0.6
" " 60 " "	1.5
" " 80 " "	2.1
" " 100 " "	7.5
" " 120 " "	0.4
" " 180 " "	28.7
Passed through 180 sieve	56.6
Loss	2.1
	100.0

The composition of an average sample (No. 1) taken at intervals during the grinding of the coal, and of a sample (No. 2) taken towards the end of the grinding, are given below.

Mark.	No. 1 Record. 10996. Per cent.	No. 2 Record 10997. Per cent.
Water at 100° C.	7.96	7.31
Water above 100° C.	6.56	6.17
Volatile matter	29.73	27.61
Fixed carbon	43.31	44.39
Ash	12.44	12.52
Total	100.00	100.00

The result of the trial shows that given:—

(1) Well dried and finely powdered coal,

(2) Incandescent surface to ensure ignition,

(3) Slight preheating of the blast (probably not more than to 120° F.), there is not the slightest difficulty in burning cement clinker with the coal. The question thus becomes purely one of economics.

It is also probable that, given a boiler with a sufficiency of incandescent brickwork to insure ignition, the coal would be fired satisfactorily. Reverberatory furnaces would also be suited to the use of pulverised coal.

R. Lockhart Jack, Assistant Government Geologist.

APPENDIX C.

Notes on a Further Trial of Leigh Creek Coal in a Cement Kiln

Department of Mines, Flinders Street, Adelaide, March 25th, 1919.

A parcel of 60 tons was tested on February 3rd and 4th, 1919, in the cement kiln of the Adelaide Cement Company, *vide* report of February 18th, 1919 (D.M., 807/18) by the manager.

A visit was paid in the forenoon of the 4th by the writer. The kiln was stopped at 11 a.m. owing to the choking of the feed at about 1 a.m. It was restarted while the writer was present, and the heat was being picked up when a further clogging occurred.

The coal dust contained 19 per cent. of moisture, against 15 per cent. in the 5-ton lot, which caused no trouble in feeding.

It is obvious that the drier installed before the tube mills, which was designed to handle about half the amount of Newcastle coal, with, say, 2.3 per cent. of moisture, was not capable of drying double the tonnage of Leigh Creek coal, containing well over 20 per cent. of moisture.

The pulverised coal looked dry, but on balling in the hand had a slight tendency to cake, and this property blocked the screw conveyor feed into the blast pipe. When actually running, the heat and flame produced was satisfactory.

The manager gives a ratio of from 2 tons to 2.25 tons to 1 ton of Newcastle medium-quality slack coal. If the delay, loss of heat and coal due to the stoppage be considered, it appears probable that the better figure

might be accepted. The samples were taken at intervals from the outlet of the tube mill and placed in a closed bottle. They had the following composition:—

	No. 1. Per cent.	No. 2. Per cent.
Water at 100deg. C.	16.57	16.01
Water above 100deg. C.	2.81	2.61
Volatile matter	25.60	26.37
Fixed carbon	37.99	38.24
Ash	17.03	16.77
	100.00	100.00
Sulphur	0.32	0.23

R. Lockhart Jack, Assistant Government Geologist.

APPENDIX D.

Notes on the Use of Pulverised Leigh Creek Coal, by the Chief Inspector of Steam Boilers, Department of Industry, Adelaide.

In considering generally the possibility of using Leigh Creek coal commercially, it seems to me that under present conditions the most reasonable chance of success lies in using the fuel in powdered form in locomotives. I have got together data from different sources, and endeavored to make a fair comparison between the data obtained and the data obtained from time to time on Leigh Creek fuel. I am presenting the report to the Committee for general discussion, with the hope that finality may be obtained in this direction.

History.—Powdered coal has been considered seriously for stationary and locomotive boilers since 1912, and during 1916 and 1917 much headway was made, and the following, among other companies, are contributing to the results:—

The Missouri, Kansas, and Texas Railway Company, using bituminous coal and lignites.

The Swedish State railway, using peat.

The Central Railway of Brazil, using bituminous coal with very high and troublesome ash content, 26 per cent. to 30 per cent.

The Delaware and Hudson Railroad, using bituminous coal and anthracite mixed.

Taken in their order, the fuels referred to have the following characteristics:—

The Missouri, Kansas, and Texas Railway Company lignites give the following analysis:—

	Per cent.
Moisture	32.97
Volatile matter	33.95
Fixed carbon	25.5
Ash	7.58

The Swedish State railways use peat with 90 per cent. moisture, the dried product containing as much energy as fair English coal.

The Central Railway of Brazil uses coal of the following composition:—

	Per cent.
Moisture	2 to 8
Sulphur	3 to 9
Volatile matter	14 to 28
Fixed carbon	34 to 58
Ash	26 to 30

The Delaware and Hudson Railroad uses a mixture of 60 per cent. anthracite slush and 40 per cent. pulverised bituminous coal, the composition of these coals being:—

Anthracite Slush.	Per cent.	Bituminous Coal.	Per cent.
Moisture	0.50	Moisture	0.5
Volatile matter	8.30	Volatile matter	33.0
Fixed carbon	72.09	Fixed carbon	57.5
Ash	12.22	Ash	9.0

The above information is taken mostly from the Department of Scientific and Industrial Research Proceedings, London. Fuel Research Board. Special Report No. 1 on Pulverised Coal Systems in America, by Leonard C. Harvey.

Leigh Creek Coal.—Analysis of sample from Peterborough, taken without any attempt at picking, about October 25th, 1917:—

	Per cent.
Moisture	25.3
Volatile matter	24.8
Fixed carbon	40.4
Ash	9.5
Calorific value	7,460 B.T. units

It may therefore be taken as granted that Leigh Creek coal should be suitable for pulverising.

Relative Cost.—It is necessary when using pulverised fuel to eliminate the moisture. Leigh Creek coal should then average 10,000 B.T. units.

Mining Cost.—12s. 6d. per ton of coal as mined; 16s. 8d. per ton of coal free from moisture.

The cost of pulverising is given for a plant installed, of 20 tons per day capacity. Taking Harvey's figures for a 20-ton capacity mill, and with wages on a war basis, the actual cost of pulverising is given at 3s. 2d. per ton, made up as follows:—

Labor, 2s. 7½d.; drier fuel, 3d.; power, 3½d.; and adding 14 per cent. on £10,000 for interest and depreciation = 4s. 8d. per ton; total cost of pulverising = 7s. 10d. per ton.

Cost of 1 ton of pulverised fuel on a locomotive tender at Leigh Creek, 16s. 8d., + 7s. 10d. = 24s. 6d.

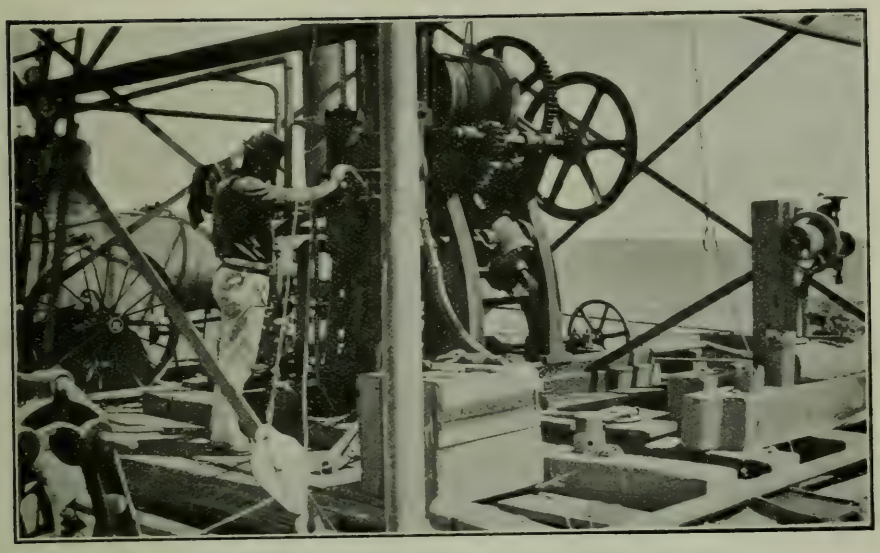
Freight, Leigh Creek to Port Augusta, 12s. 2d.

Total cost of Leigh Creek pulverised fuel at Port Augusta, 36s. 8d.

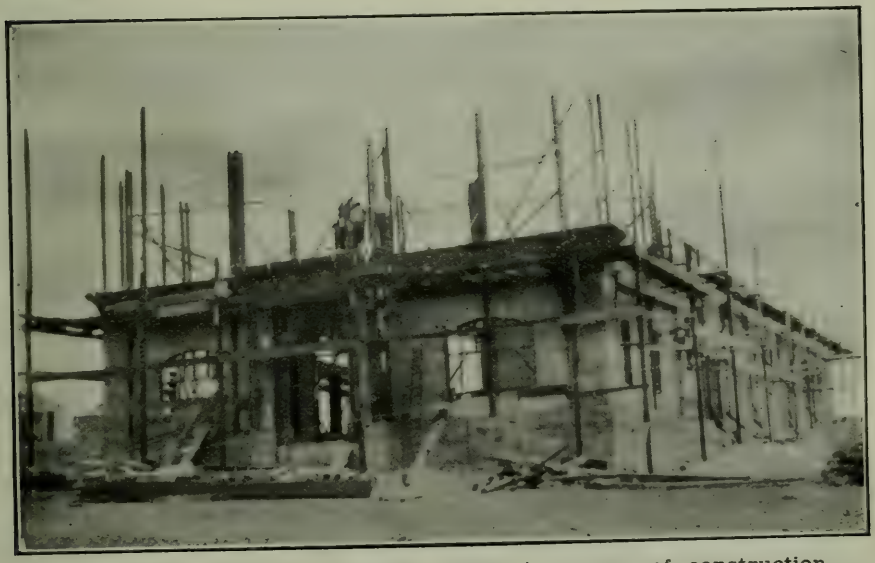
Freight, Leigh Creek to Quorn, 10s. 8d.

Total cost Leigh Creek coal at Quorn, 35s. 2d.

In actual practice with low-grade fuels, pulverising increases the efficiency of the fuel in a locomotive boiler by 20 per cent., thus increasing the moisture-free fuel of 10,000 B.T. units by 20 per cent, would give an equivalent



The Calyx Drill at Work, Leigh Creek.



New Institute Building, Hummock Hill, in course of construction.

Face p. 48.]

value of 12,000 B.T. units. So, in rating the Leigh Creek pulverised fuel at 12,000 B.T. units, as against 13,000 B.T. units of Newcastle lump coal, a fair average is struck, and comparisons of the fuel may be had on the ratio of 12 : 13, then 1 ton of Newcastle lump coal is equal to 1.083 tons of Leigh Creek coal.

For purposes of comparison, take 1.1 tons of Leigh Creek powdered fuel to give results equal to 1 ton of Newcastle lump coal.

Allowing Quorn to be a centre from which either lump or pulverised fuel may be used, the total cost of 1 ton of Leigh Creek fuel will be made up as follows:—

	s.	*d.*
One ton of powdered fuel	16	8
Crushing, drying, and pulverising moisture-free coal	3	2
Interest and depreciation on plant and buildings valued at £10,000, at 14 per cent.	4	8
Freight on 1 ton Leigh Creek coal to Quorn	10	8
Total	35	2
The cost of 1.1 tons of powdered fuel at Quorn will then be	38	8½

These figures show the cost if freight were allowed for on a commercial basis; but it will be clearly understood that, whatever fuel is used, it must be hauled in one direction, so that on the journey from Leigh Creek to Quorn, the value of the fuel starting from the mine is 24s. 6d., which is a direct gain compared with Newcastle coal at approximately 34s., and the return journey is started with a fuel value of 38s. 8d. My conclusions now are that it should be a reasonably safe proposition to suggest that a full-power test should be given to Leigh Creek coal on a locomotive, under running conditions. If this is not possible, then I suggest that a complete plant be purchased, a complete tender designed and constructed, and a locomotive altered to make the necessary experiments—the pulverising plant to be erected at Leigh Creek.

JAS. P. BURNSIDE, Chief Inspector of Steam Boilers.

September 16th, 1919.

REPORTS

BY THE

Assistant Government Geologist (R. Lockhart Jack, B.E., F.G.S.)

NOTES ON AN ALLUVIAL GOLD DEPOSIT ON SECTION 586, HUNDRED OF BAROSSA.

A crushing of 8 tons of gravelly wash has recently been treated at the Peterborough Government battery for a return of £8 3s. 2d. of gold, equal to £1 0s. 4¾d. per ton by amalgamation. The tailings assayed a trace only.

The deposit is a high level Tertiary gravel resting on the lip of the gorge cut by the North Para River into the Pre-Cambrian rocks at the extreme north-east corner of section 586, hundred of Barossa.

The face exposed consists of about 200ft., facing west to the river, and about the same length facing north. To the north the deposit has been totally removed; to the west it ends against a bar of old rock. To the east the boundary of the section is only a few yards distant, but the Tertiary gravel extends beneath the road into the adjoining section. To the southward the gravel persists for a considerable distance. In this direction two to three hundred yards south there are two old shafts exposing gravel, but the results obtained are stated to have been unsatisfactory.

On the river face, workings have been carried in for about 30ft. to the eastward, and one for a greater distance to the southward, evidently following gravel layers of sand resting on the decomposed (pipeclay) bedrock.

Mr. Schuppan, who worked the deposit 31 years ago, states that all drives were made on a pipeclay, and that the gold was continuous on the bottom over the length of the drives. The south drive, from the mouth of which the recent crushing was taken, was inaccessible, but extended some distance, and was stated to have carried gold to the end.

Sluicing on a small scale has been done, but the results were apparently not very satisfactory, possibly because the bulk of the gold was very fine, and a simple sluice-box was not suitable to recover it owing to the depth and velocity of the current required to remove the coarse gravel.

The recent crushing was stripped from a face 6ft. high, and gave the result stated above.

Here the deposit is made up of layers of coarse gravel and layers of medium-grained sand, in places cemented by iron oxide. The gravel or wash breaks up readily, and being free from clay, is easily washed or sieved. The gold, as far as can be seen, is fine. Two gullies have been washed out through the deposit, and it would be advisable to test them for alluvial by sinking to bedrock, as there is every possibility of secondary concentration of the alluvial of the terrace gravel having taken place.

Until more is known of the distribution of the gold it is impossible to indicate the best method of treatment.

The face that yielded the recent crushing was sampled in 2ft. heights, and the samples panned, the coarse gravel being saved for assay to determine the distribution of the gold.

Fines about.	Gold.	Coarse gravel. ½in. and upwards.	Assay of coarse gravel.
Lowest two feet 50 per cent.	A few fine colours	50 per cent.	Nil.
Middle " 50 "	No colours.	50 "	Nil.
Upper " 60 "	No colours.	40 "	Nil.

These results would seem to indicate that

(*a*) The gold is in the fines.

(*b*) The pebbles are barren.

(*c*) A very large proportion of the pay streak could be rejected by screening, with corresponding saving of cartage if the material is to be sent to a battery.

The deposit could best be tested by the following method:—

(*a*) Try for alluvial in the two gullies crossing the deposit.

(*b*) Clean the old faces to bedrock and sample in heights of not more than 2ft., or in accordance with any definite layers, taking samples of about 20lbs. to 30lbs. per foot of height sampled.

(*c*) Sieve the samples through (about) a ¼in. or ⅜in. sieve, estimating the proportions of under and oversize material.

(*d*) Pan the fines and make a note of the estimated amount of gold, the thickness the sample represents, and the proportion of fines present.

If these results when collected appear promising, two or more shafts could be sunk to bedrock 50ft. to 100ft. back from the innermost exposures and sampled. These shafts would enable an estimate of tonnage to be made, from which it would be decided whether the cost of a plant to treat the gravel locally would be justified by the saving in carriage.

The following comparison of costs to get material to the Government batteries and treated may be made:—

	Peterborough.		Mount Torrens.	
	Miles.	Estimated Cost.	Miles.	Estimated Cost.
Cost of mining	—	Common	—	Common.
Cost of bagging	—	Advisable	—	Not required.
Cartage to Lyndoch	3	5/-	3	5/-
Lyndoch to	140·25	12/6	75·5	7/7
Railway to battery	—	2/1	2¾	4/-
Treatment	—	5/-	—	5/-
		24/7	—	21/7

The transport costs are:—To Peterborough, 19s. 7d., and to Mount Torrens, 16s. 7d. per ton. Costs of cartage at Lyndoch and Mount Torrens are estimated.

From these figures it is evident that the margin over transport costs is too small to permit of mining and crushing ore of the grade of that tested, but does indicate that if 50 per cent. of barren pebbles be rejected it would

be possible to cut transport and treatment charges in half, or to 10s. 9d. per ton of original ore, and cost of screening, say 1s. 3d., a total of 12s., leaving 8s. on the original weight of ore for the cost of mining and profit.

Even so, if there is sufficient ore to provide for the redemption of plant to the extent of less than 7s. per ton of ore as mined, it would be preferable to treat the material locally.

Such a plant might consist of—

(1) Apparatus to sieve out coarse gravel, say about ½in.

(2) A sluice with ripples to catch any heavy gold.

(3) A fine screen to reject fine gravel and to pass fine gold and fine sand and water on to

(4) Wide inclined tables covered with blankets to catch fine gold from a shallow stream flowing over them.

(5) Power and pump to raise water from the river to sluice.

If a tonnage of 400 tons or more can be proved—and it is probable that it can be—by the suggestions for prospecting outlined above, to contain gold in reasonable quantity, there is no doubt that provision should be made to treat the material on the spot. A ton of gravel in place may be taken as occupying 18 cub. ft. (29-8-19.)

REPORT ON RECENT DEVELOPMENT IN NO. 3 SHAFT OF THE ULEY GRAPHITE SYNDICATE, M.L. NO. 2329.

This shaft and its workings to a depth of 37ft. was examined and sampled by the Director of Mines and the writer in June, 1918, and the results are recorded in Mining Review No. 28.

Recently the shaft was deepened to a depth of 64ft., and a crosscut driven in a general direction of W. 16° N. for a length of 100ft. at the 60ft. level. The ground is soft, and requires timbering, and water was making at the rate of about 60galls. per hour. Graphite was carried in the shaft to a depth of about 48ft., when the material passed through became very poor.

The crosscut for a distance of 45ft. passed through soft clayey material, in which graphite was very sparsely distributed. There are better portions, but too small to enrich the mass to a commercial grade. This is indicated by samples 15, 14, and 16, which were cut along the side of the crosscut, over lengths of 11ft., 17ft., and 17ft. respectively.

Payable ore was entered 50½ft. from the shaft. From there to the face, 49½ft., the orebody is of good grade, and was sampled in 5½ft. lengths.

Although the ground is still soft, the flake graphite is considerably stronger and brighter than on the level above, and has a carbon content well in excess of the minimum standard of 80 per cent.

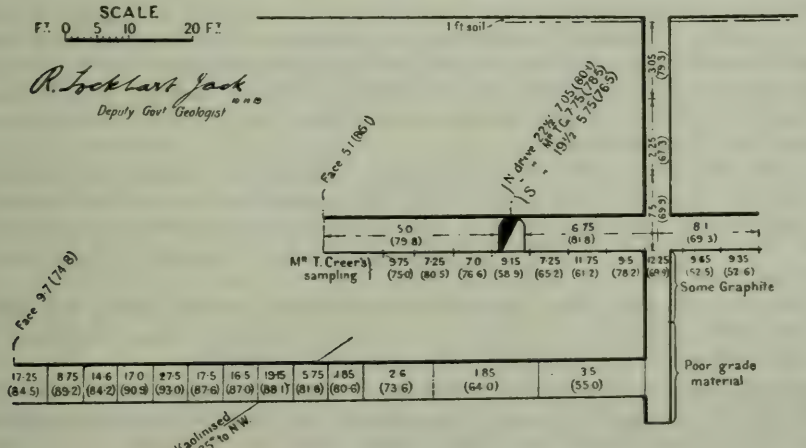
The face shows good grade ore (sample 17), except for a lens of barren kaolin about a foot in thickness, which dips 30° to the N.N.E., and which was excluded from the sample.

The attitude of the body still remains somewhat obscure; there are a number of heads and some small kaolin seams dipping to the N.N.E., and striking approximately parallel to the crosscut, but the general appearance of dip of the various grade zones, and of a narrow barren portion dipping 35° N.W., indicate that the strike is probably between N.N.E. and N.E., and this is confirmed by the indications in the crosscut overhead and in the No. 1 shaft workings on a seemingly parallel body.

The following samples were taken in the lower crosscut:—

	No.	Locality, West of shaft.	Length.	Per cent of flake recovered.	Per cent. of carbon in concentrated flake.
		Feet. Feet.	Feet.		
Low grade	16	0 - 17	17	3·5	55·0
	14	17 - 34	17	1·85	64·0
	15	34 - 45	11	2·6	73·6
	13	45 - 50½	5½	1·85	80·6
Lode	12	50½ - 56	5½	5·75	81·6
	11	56 - 61½	5½	19·15	88·1
	10	61½ - 67	5½	16·5	87·0
	9	67 - 72½	5½	17·5	87·6
	8	72½ - 78	5½	27·5	93·0
	7	78 - 83½	5½	17 0	90·9
	6	83½ - 89	5½	14·6	84·2
	5	89 - 94½	5½	8·75	89·2
	4	94½ - 100	5½	17·25	84·5
Face	17	Face excluding 12in. barren band	—	9·7	74·8
Average of samples 4-12, represents 49½ feet of lode material				16·0	88·3

The workings and the location and values of samples taken on this and the previous examination are indicated on the accompanying cross-section,



Assay Section.

as well as the first sampling of the 37ft. level carried out by the manager, Mr. T. Creer, the samples being treated by the Government Metallurgist. This section shows that the values dip to the W.N.W. rather flatly in the eastern portion, but apparently there is a steepening of dip to the westward.

The upper portion of the shaft shows a low percentage of recoverable flake, the graphite present being tender, and so contaminated by limonite as to be largely broken up to less than 80 mesh in the effort to dress it to a concentrate containing 80 per cent. of carbon.

In the upper crosscut and drives the iron had much less effect, except in the eastern crosscut, where the ore was still ferruginous, and concentrate of merchantable grade was made without difficulty from the rest of the material.

The crosscut exposed 52½ft. of payable material, and the drives at right angles total 45ft. in length. With a small amount of rejection (*vide* Review 28, p. 43) of low-grade material, 7 per cent. should be recoverable from ore exposed on this level. The faces of both the crosscut and the drives are in ore, and there is no sign of the limits of the deposit.

At the bottom level the orebody is practically iron free, and the flake is bright and tough. A proportion of finely divided graphite is present at this depth.

The drive, after passing through low-grade material containing an average of 2.05 per cent. of flake (62.7 per cent. carbon) for 50½ft., entered and continued in payable material for a length of 49½ft., the average concentrate produced being 16.0 per cent., assaying 88.3 per cent. of carbon. The face is still in ore, a sample yielding 9.7 per cent. of flake, assaying 74.8 per cent. of carbon, and the crosscut should be extended so long as the material continues payable. When the western side is reached the question of driving north and south might be considered.

The ore actually blocked out and developed by this working is 52ft. east and west and 45ft. north and south, by a height above the 60ft. level of not less than 36ft. (possibly more). This, at 18 cub. ft. to the ton, is approximately 5,000 tons, which should have a recoverable value of 11.0 per cent. of flake of 80 per cent. carbon or better.

From the indications of shallow workings and the surface there is every reason to expect that the orebody has a considerable longitudinal extension, and it is quite reasonable to assume for purposes of calculation that ore of similar quality extends for at least 50ft. beyond the faces of the drives off the upper crosscut. Such an assumption gives a further 10,000 tons of ore, not fully developed as in the case of the 5,000 tons, but which may be defined as "probable ore."

The richness of the ore in the lower crosscut indicates that a very considerable quantity of graphite will be recovered in a few feet of additional depth. An area 50ft. x 45ft. x 10ft. deep, at 16 per cent., and 18 cub. ft. to the ton, should yield 200 tons of flake, assaying 88 per cent. of carbon.

It thus appears that there is ore blocked out and in sight above the 60ft. level and over a length of 45ft., to the extent of 5,000 tons, that should yield 550 tons of flake, worth £11,000 gross at £20 per ton.

Probable ore is estimated as 10,000 tons (50ft. each way along the lode beyond the faces of the drives), that should not differ much in graphite content from that blocked out, and a block 45ft. by 50ft. wide, and 10ft. below the 60ft. level crosscut, or 1,250 tons, capable of yielding about 16 per cent., or 200 tons of flake graphite of 88 per cent. carbon, worth, at £24 per ton, £4,800 gross.

Costs were estimated by the Director of Mines and the writer (Review No. 28) as not likely to exceed 16s. per ton for mining and milling. With an increased proportion of finished product to be handled, the costs would be a little higher, say 18s. per ton.

This, on the 5,000 tons of ore in sight, would amount to £4,500, so that this block of ore would not only pay for mining and treatment, but for the mill, without taking into consideration the future treatment of the probable ore.

This tonnage must not be taken as the total possible from the mine, but only as that so certain to be present that it can be used as a basis for calculation of production for, say, 16 months at 40 tons a day.

The extension of the crosscut and other work will undoubtedly prove further ore when carried out.

The working known as the House Shaft had been sunk in a costeen immediately north of the house, and a rich body of graphite ore struck. This ore contains both very high-grade flake, and graphite so finely divided as to be classed as amorphous. At 20ft. in depth the body has been followed by a drive for 7ft. south and 25ft. north of the shaft. A small winze has been sunk in the north drive.

The footwall of the orebody is exposed in several places, and dips 50° W. The western wall is exposed in a small crosscut west of the shaft and opposite the winze, and is vertical. The winze, 3ft. in depth, showed the ore to pinch out in the bottom, and the body has the appearance of pitching flatly to the north.

The following samples were taken in the drive:—

No.	Locality.	Width.	Remarks.	Percentage of Flake Recovered.	Carbon in Flake.
		Feet.			Per cent.
1	North face	3	No walls exposed	8·85	85·2
2	At shaft	6½	Both walls exposed	10·1	91·2
3	South face	3	Footwall exposed	7·1	95·0

While the grade is good the tonnage is relatively small, and can only be regarded as an accessory to the main body of No. 3 shaft.

The old No. 1 shaft crosscut at 26ft. depth exposed 2½ft. of ore, which yielded 12 per cent. of flake, assaying 88.7 per cent. of carbon. This was a non-ferruginous band in a width of material sampled of 24ft. 6in., which carried ferruginous flake (Review 27, p. 60) to the extent of 12 per cent., assaying 48.7 per cent. of carbon. The probability of diminution of the iron in depth, with corresponding benefit to the flake, and the fact that there is a body rich enough to follow and stope out, containing 12 per cent. of high-grade flake, renders this development of value.

This body in No. 1 shaft is not that of No. 3 shaft, and is separated from it by a low-grade zone, the width of which is not yet known.

Future Methods of Working.

While the House Shaft and No. 1 shaft bodies on present indications may be best worked by underground methods, the No. 3 shaft body suggests open-cutting.

There are two possible sites for a mill—one about 140ft. east of No. 3 shaft, where the ground falls about 5ft. to 7ft. in a hundred; and the other to the N.N.E., where the fall is somewhat steeper. The latter site, however,

is probably on the top of the orebody, and should be avoided, while the eastern site appears to be on barren ground.

An incline through No. 3 shaft on the footwall of the orebody could lead direct to the mill bin, material being raised by side-tipping truck either to the bin or to a track to the waste dump.

A considerable proportion of overburden could be removed by plough and scoop, leaving only the deeper material to be hoisted in trucks. The bulk of the ore could be gravitated from the working faces into trucks, which, when the bottom of the open cut had been reached, could be brought under the working faces where desired. The material to 60ft. is practically all soft, and little if any explosive need be used. Probably the open cut could be extended to a greater depth, but this will be determined by further development of ore in the extension of the crosscut at the 60ft. level or by actual mining. (11-11-19.)

REPORTS

BY

The Chief Inspector of Mines (L. J. Winton, B.E.)

REPORT ON THE AUSTRALIAN SLATE QUARRY, WILLUNGA.

(*Vide* Review No. 14.)

This quarry, which was formerly known as the Bangor Quarry, is situated on part of section 756, in the hundred of Willunga, to the south of the township and railway station of Willunga.

A good road two miles in length connects the quarry to the railway station, and the grade, although steep in places, is in favor of the load, being mostly downhill to the railway station, from which the distance to Adelaide is 34¼ miles.

A broad belt of slate, striking N. 25° E., and dipping S.E. at angles varying from 63° to 72°, outcrops in the hills to the south of Willunga, and is the source from which both roofing and flagging slate is obtained, the quarries having been worked at various periods during the past 40 years or more.

The age of the slate is Upper Pre-Cambrian or Lower Cambrian, its exact position within these limits not having been accurately determined yet.

The width of the slate belt is about 300ft., and the distance between Martin's Quarry and the Australian Slate Quarry, both on the same belt, is about three-quarters of a mile.

Judging by the size of the excavation, a considerable amount of slate has been obtained from here during past operations, and work has now been begun again by the present owner, who has already produced over 150,000 roofing slates.

The quarry is very well situated, being opened up on the southerly flank of a high hill, through which the belt of slate passes, and having a deep gully immediately in front, in which waste can be easily and cheaply dumped.

The quarry face at present is about 150ft. high, and has been opened up across the strike of the slate in a N.W.—S.E. direction, advantage having been taken of a joint-plane which dips against the dip of the slate, and which obviated the necessity of undercutting the latter.

The present owner has sunk below the level of the old quarry floor, working in an open cut 15ft. or 20ft. below that level, and the slate thus obtained would be probably 100ft. or more below the original surface level, and should thus be free from any defects of weathering.

Roofing slates are produced in all trade sizes, and the thickness of the finished slates ranged from 3 to one inch, down to 6 to one inch, and the custom in disposing of the slates is to sell at per thousand.

The whole of the slate belt is not always suitable for quarrying, as some portions are useless, owing to the presence of quartz and calcite seams, or are damaged by rolls or by too close a system of cross-jointing, but these portions can be avoided or discarded, and the supply of good quality slate appears unlimited.

The slate is of a very uniform grey-blue color, and is free from spots or patches or ribbon markings, and from observations of old slates in the quarries and on the roofs of old buildings, does not appear to fade to any extent.

Very little pyrites is seen, or iron stains, but the slate is of a calcareous nature, and shows effervescence with the application of cold hydrochloric acid, even where no calcite is visible to the unaided eye.

The cleavage of the slate, which is parallel to the bedding-planes, is well developed, and the finished slate, which has a somewhat rough surface, gives a good sound when struck.

The following details regarding the analysis and testing of some samples of roofing slate from the Australian Slate Quarry are taken from *Architecture*, August 20th, 1919, being portion of an article on the Adelaide (Willunga) slate, written by Mr. John Dunstan, one of the proprietors of the quarry.

The specimens of Adelaide slate referred to are understood to be specimens taken by a visiting architect from the Australian Slate Quarry at a depth of about 100ft. from the surface. They should therefore represent the best quality obtainable, and should be free from the influence of weathering.

An analysis was made of one of these samples by Mr. Chapman, of the School of Mines, and is as follows:—

	Per cent.
Silica (SiO_2)	53·64
Alumina (Al_2O_3)	14·90
Ferric oxide (Fe_2O_3)	0·64
Ferrous oxide (FeO)	4·87
Magnesia (MgO)	4·60
Lime (CaO)	6·46
Soda (Na_2O)	1·06
Potash (K_2O)	3·02
Water at 100°C.	0·14
Water above 100°C.	4·65
Carbon dioxide (CO_2)	4·75
Titanic dioxide (TiO_2)	0·75
Phosphoric anhydride (P_2O_5)	0 37
Sulphur trioxide (SO_3)	nil.
Chlorine (Cl)	—
Ferric disulphide (FeS_2)	0·54
Chromium sesquioxide (Cr_2O_3)	—
Manganous oxide (MnO)	0 06
Barium oxide (BaO)	—
Strontium oxide (SrO)	—
	100·45

A statement is also given in the same article of the particulars of a test made by Professor Warren, of the Engineering School of the Sydney University, on the Adelaide slate, and also on slate stated to be best purple Bangor slate. The particulars are as follows:—

P. N. Russell, Engineering Laboratory, University of Sydney.

Test—Slate—Crossbreaking and Hardness.

Nature of Specimen.	Span. l	Width. b	Thickness d	Load in lbs. Central W	Modulus of Rupture pounds per sq. inch.	Resistance to punching under drop hammer inch-lbs.	Brinell hardness.	Relative hardness.
	Inch	Inch.	Inch.					
Adelaide Slate ..	12	9	0·18	160	9376	80	122	1·0
" " ..	12	9	0·16	135	10547	80	119	0·97
" " ..	12	9	0 21	230	10130	60	101	0·82
" " ..	12	9	0·21	232	10521	60	92	0·75
Best Purple Bangor Slate	12	9	0·15	130	11556	60	114	0·93
" " ..	12	9	0·16	135	10546	68	88	0·72

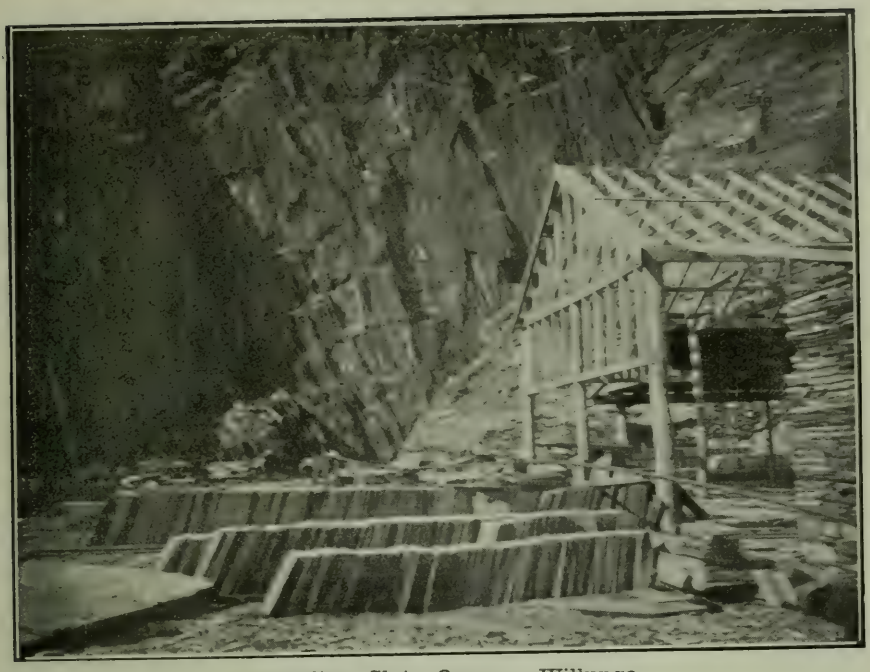
It is remarked that the tests of the Bangor slates (which are understood to be imported slates) were for comparative purposes only.

The load on the Brinell machine was 500 kilogrammes for one minute.

The formula for the modulus of rupture is:—

$$f = \frac{3wl}{2bd^2}$$

The amount of carbonate of lime present in the slate, as shown by the foregoing analysis, is high.



Australian Slate Quarry, Willunga.

Australian Slate Quarry, Willunga, Lowest Workings.

Face p. 58.]

In a series of selected analyses of 13 varieties of European slate and one variety of American slate, given in Bulletin No. 586 of the U.S. Geological Survey, the amount of lime ranges from 0.19 per cent. to 5.2 per cent., and a summary of analyses of eight varieties of American slate given in the same work, shows the percentage of lime to range from 0.33 per cent. to 4.23 per cent., the general average being 1.47 per cent. The amount of carbonate of lime present in a slate has an influence on its durability, as the carbonate of lime is acted upon by any acids present in the atmosphere, and the slate which contains the most carbonate of lime will naturally suffer the most deterioration, in the course of time.

This fact indicates that the best use of this slate for roofing purposes would be in places where the atmosphere contained the least amount of acid, and that the slate would not be as durable in a manufacturing town or district, where the amount of acid in the air is greatest, as in residential districts or the open country.

Tests made on 33 specimens of nine different kinds of American roofing slate by Professor Mansfield Merriman, of Leigh University, gave results for the strength, that is the modulus of rupture in pounds per square inch, ranging from 3,470lb. per square inch to 12,490lbs. per square inch, the average for the 33 specimens being 8,698lbs. per square inch.

An ordinary crane is at present used for raising the slate from the pit, but a petrol-driven winch is being erected, which will supersede this, and will be both quicker and cheaper in operation.

Power for boring and dressing is furnished by a 16h.p. oil engine, which drives a compressor and several slate-trimming machines. In mining the slate no explosives are used, as their use is found to injure the slate, but where necessary the slate is channelled with a pneumatic chisel, and a few holes bored along the side by means of a jackhammer enable the block of slate to be split free from the general body.

A large slab of slate is thus wedged free from the face, and is split into suitable thickness in the quarry, the large thin slabs being then hoisted out, and taken on trollies to the dressing floors. Here they are cut into sizes convenient for handling, and are then split into the required thickness, and finally trimmed by means of power-driven trimming machines, the blade of which operates similarly to the blade of a lawn mower. These machines are furnished with a gauge, and the operator can cut and square the slates to the best advantage. Each machine is said to be capable of squaring 1,500 slates per day.

The slates are then stacked according to size and thickness, and are ready for dispatch.

It is found to be advantageous to allow the quarried slate to remain exposed for a week or a fortnight before the final splitting and trimming, as the splitting is materially assisted thereby.

Some trimming and sawing machines of the latest pattern have been ordered, and will be erected before long.

As there is a considerable amount of waste in slate quarrying, various attempts have been made to turn the waste to some use. In the first place, a slate-splitting machine has been invented which is said to be effective and economical, making much less waste than the ordinary hand methods.

There is also said to be an increasing use of graduated slates, that is, in covering a roof the slates used are thick near the bottom and decrease in thickness as they approach the ridge, and slates with poor cleavage, which will not split thin, can thus be used.

A roofing consisting of 3in. squares of slate bedded in asphalt, with a backing of roofing felt, has also been manufactured.

Powdered and granulated waste is also used in the manufacture of oilcloth and roof covering.

In Norway finely powdered slate waste is mixed with casein, the nitrogenous constituent of milk, and coloring matter if required, and the product is moulded or pressed into various shapes, and designs imprinted on it if required. Blocks and sheets are made suitable for wall coverings, mantelpieces, &c. (21-10-19.)

REPORT ON SOME GOLD WORKINGS ON FIFTH CREEK.

These workings are on Mr. W. Holliday's property, on Fifth Creek, in the hundred of Adelaide.

A considerable amount of alluvial gold is stated to have been obtained in the past from this creek, and the present work has been carried out with the object of finding a lode or lodes from which the alluvial may have been derived.

In the creek bed some work has been done on an outcrop of quartz and quartzite, which, however, cannot be traced for any distance.

Iron pyrites and limonite occur in small amount in the outcrop, the decomposition of the pyrites in places causing the rock to be cellular and iron-stained.

Three samples were taken from here, the first of which was a general sample taken from various parts of the exposure:—

Sample No. 1—Ferruginous quartz; gold, nil.

The next sample was of quartz carrying a fair amount of pyrites, to ascertain if the pyrites carried any appreciable quantities of gold:—

Sample No. 2—Quartz and pyrites; gold, nil.

No. 2 sample was taken from the eastern end of the hole, and another sample was taken from a little above this:—

Sample No. 3—Ferruginous quartz and pyrites; gold, nil.

Farther up the creek a short drive has been put into the side of the hill a few feet above creek level, and at the entrance a shaft has been sunk, which is said to be 50ft. deep, but being practically at creek level, it was full of water, and could not be examined.

An examination of the drive, which is in slate, showed no sign of a lode, the only feature being a fault-plane showing a little soft filling, and it was not obvious why a shaft had been sunk here.

Some distance up the slope of the hill another shaft has been sunk about 50ft. in depth, on a quartz outcropping. The ladders did not extend to the bottom, but as far as could be seen the shaft had passed out of the quartz formation at a little depth.

A sample was taken from the quartz outcropping here, but gave no value for gold.

Sample No. 4—Quartz; gold, nil.

None of the samples taken showed the presence of gold, and it seems as though the shaft sinking had been undertaken without sufficient evidence to go upon, and that further prospecting and some indication of the presence of gold were needed before sinking was begun.

In endeavoring to ascertain the source of alluvial gold, much time and patience are often required in prospecting and washing and loaming.

There is always the possibility also that the gold may have been shed from a number of small veins, or from a large but poor lode, in which case the source of the gold, even if found, might not be worth working.

Any further work done here should be of simple prospecting nature by washing or sampling, to see if any formation can be found carrying any gold. If such can be found the question of sinking or otherwise opening it up might be considered.

Without some trace at least of values in the outcrop, the expense of shaft sinking is hardly justifiable. (25-11-19.)

REPORT ON THE ROYAL GEORGE GOLD MINE, TARCOOLA.

(*Vide* p. 297, Record of Mines and Mining Review, No. 23.)

The property consists of gold lease 1505, of 20 acres, held by S. H. Trewartha, and is situated about 3 miles W. of old Tarcoola township, and about 1½ miles W. by N. from the Tarcoola Blocks Gold Mine, in slightly undulating country.

The mine has been developed by three shafts. No. 1, or main shaft, is vertical, and sunk to a depth of 144ft., mostly in granite; No. 2 shaft is sunk vertically for a few feet, and then on an underlie to the W. to a total vertical depth of about 104ft. No. 3 shaft is also vertical for 20ft., and then goes down on an underlie to the W. to a vertical depth of about 80ft.

Plan of Lease, Royal George Gold Mine.

All the stoping has been done from the No. 2 shaft, both N. and S., for a total length of 130ft., and extending from about the 70ft. level up to within 28ft. of the surface.

At a depth of 104ft. a level has been driven to the N. from the main shaft, in more or less decomposed granite, and is connected to the No. 2 shaft, and by a devious route finally joins a level from the No. 3 shaft, at a depth of about 80ft. from the surface. No stoping has been done from any of these drives, which have a total extent from N. to S. of 240ft.

The gold-bearing formation cannot be traced on the surface, which shows a thin layer of travertine beneath the soil, and it is difficult to follow it underground also, without the aid of sampling, as the gold appears to occur

in the granite itself, and there is not any defined formation which can be followed. The granite is more or less decomposed, and in places shows large masses of kaolin, sometimes stained by iron, and in places small aggregations of quartz. Some of the granite contains a considerable amount of limonite disseminated through it in finely divided state, and possibly the gold is associated with this, and with the kaolin, as in the Perseverance Mine not far away.

The angle of dip of the No. 2 shaft, and the stope therefrom, is 50° to the W.S.W., and in the south end of the stope large masses of kaolin occur. The main shaft is in solid granite, and the bottom level appears to have been driven on a seam of fine-grained, dark and decomposed material, which, however, gave no value for gold on assay. At present work is confined to a place in the side of the old stope, a little above the 80ft. level. Here a wide crosscut is being driven on the east side of the stope in the partly decomposed granite, which shows stains and small seams of limonite, small quartz aggregations, and a certain amount of kaolin, finely disseminated through the rock mass.

With a view to ascertaining where the gold occurred, samples were taken from kaolin, quartz, and limonite respectively, and assayed:—

Sample No. 31, kaolin, assayed gold 1oz. 13dwts., and silver 8dwts. per ton.

Sample No. 30, quartz, assayed gold 3dwts., and silver a trace per ton.

Sample No. 32, ferruginous quartz, assayed gold nil, silver nil.

The following table gives the particulars of the sampling:—

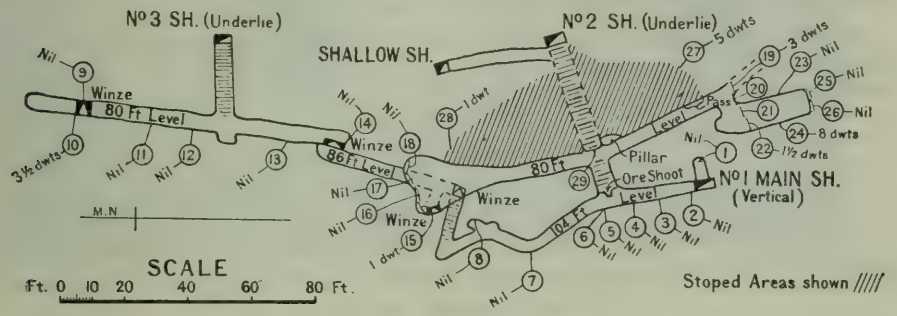
Sample No.	Width.		Gold per ton.	Silver per ton.
	feet.	inches.	oz. dwts.	oz. dwts.
1	2	9	nil	nil
2	3	9	nil	nil
3	1	2	nil	nil
4	3	0	nil	nil
5	1	2	nil	nil
6	2	0	nil	nil
7	2	6	nil	nil
8	3	6	nil	nil
9	3	0	nil	nil
10	4	0	0 3⅓	trace
11	3	6	nil	nil
12	2	6	nil	nil
13	4	6	nil	nil
14	4	0	nil	nil
15	5	9	0 1	trace
16	5	0	nil	nil
17	5	0	nil	nil
18	5	0	nil	nil
19	4	9	0 3	trace
20	4	0	0 13	trace
21	4	0	0 1	trace
22	4	0	0 1½	trace
23	4	6	nil	nil
24	4	6	0 8	trace
25	5	0	nil	nil
26	5	0	nil	nil
27	6	0	0 5	trace
28	12	0	0 1	trace
29	9	0	0 3	trace

The stoped areas have a width ranging from a few feet up to 21ft., and as there is no definite lode formation to go on, it is possible that gold may be found to occur in payable quantities outside the former stoping limits.

A number of samples were taken from the various workings of the mine, and the values of these, and their location, are shown on the accompanying plan. No high values occur amongst them, the highest being 13dwts. of gold per ton, over a width of 4ft., and the mine appears to belong to the low-grade class.

The ground is easily worked, and the ore is simple to treat, but with the low values obtained it would be necessary to mine and treat the ore on a large scale to have any chance of making the operations profitable.

No tonnage can be estimated at present, as little development work has been done, and the result of this so far is not satisfactory.



Assay—Plan of Workings, Royal George Gold Mine

No samples taken on the bottom level showed any gold, and it seems very probable that the gold-bearing formation has not been cut on this level, and that further development is necessary for that purpose.

With this view some cross-cutting to the east would first suggest itself.

The record of the amount and value of the ore from this mine treated at the Government Battery at Tarcoola shows that 977 tons have been treated, yielding 566oz. of bullion, worth £2,071, representing an average yield of 42s. per ton recovered.

Besides this amount the present proprietor has treated some ore by battery on the mine, without cyanidation.

The plant on the mine consists of a small vertical boiler and engine, which drives a three-head battery. Water is obtained for boiler and battery purposes from the main shaft sump, a deep well pump being driven by a small oil engine.

The water is saline, however, and the supply is limited, and for these reasons a steam plant is unsuitable.

For the successful working of a mine such as this, where the gold content of the ore is low, and the margin between the value of the ore and the cost of mining and treating it is small, it is necessary that a considerable tonnage should be treated, and for this purpose development is needed to ascertain whether sufficient tonnage of ore of sufficient value can be found to justify working on a larger scale.

The bulk of the ore has in the past been treated at the Government Battery at Tarcoola, a limited quantity having been put through the small battery on the mine. As previously mentioned, the present water supply on

the mine is small, and the necessity for obtaining a better supply of water would have to be considered before any attempt could be made to treat the ore on the mine on any larger scale than at present.

Summary.

The lode, as far as known at present, is ill-defined, and although the gold-bearing formation appears to be wide in places, the average value is very low. The deeper prospecting, though not conclusive, has so far failed to show any gold. On the values, as shown by the sampling, profitable operations would be possible, if at all, only by treating a considerable tonnage. The water supply is scanty and saline, and no scheme of treatment on the mine could be considered without means of augmenting this supply considerably. The development underground is not sufficient to prove any quantity of ore, and further work would be necessary to this end, as also to prove the continuation, if any, of the gold-bearing formation in depth.

As the mine stands at present a small quantity of ore can probably be obtained by selective mining, which may repay treatment by the Government battery or by the small plant on the mine. (5-1-20.)

REPORT ON THE MANGANESE DEPOSITS OF THE AUSTRALIAN MANGANESE CO., N.L.

(*Vide* Mining Reviews Nos. 21, 22, 23, and 25.)

The deposits held and worked by this company are situated on a small arm which branches off on the west side from the south end of the main Pernatty Lagoon.

The holdings are about five miles, in a direct line, a little E. of N. from Woocalla, the station at 71 miles from Port Augusta, on the East-West line.

The distance from Woocalla to the mine by present road is about eight miles, but can probably be shortened by selection of a more direct route. The country between Woocalla and the deposits is undulating, and the surface is strewn with quartzite fragments, which need to be cleared in order to afford a passable track.

The property comprises 10 mineral sections, 1134 to 1143 inclusive, held as leases, and two mineral claims, Nos. 11162 and 11155, the total area held being about 452 acres.

The main workings are on M.S. 1138, 1137, 1135, 1136, 1143, and M.C. 11162, there being but little work done on M.S. 1139, 1140, 1141, 1142, and M.C. 11155 up to the present.

A reddish quartzite or sandstone forms the bed rock of the district, and in places a siliceous conglomerate is seen, as, for instance, on M.S. 1143, where there are some small hills close to the manganese cutting, which show a capping of conglomerate now in process of disintegration, while in many places on the heights above the lake, water-worn pebbles and fragments of conglomerate can be seen. The reddish quartzite can also be seen at the Sweet Nell Copper Mine and at the Woocalla railway ballast quarry.

Miners' Camps in the Early Days at Iron Knob and Hummock Hill.
Face p. 64.]

At a point on the shore of the lake S.W. from the S.W. corner of M.S. 1134, cliffs of quartzite are seen, and from this a floor of quartzite runs out into the lake for some distance, finally giving place to dolomite.

Dolomite occurs as a sheet of varying thickness, overlying the quartzite for the most part, both in the lake bed and along the shores of the lake, with the exception of some instances, as mentioned above, where the quartzite shows through and above the dolomite. At a shaft at Mount Gunson the dolomite resting on the quartzite is seen to be 33ft. thick.

This sheet is a very extensive one, being seen along the lake shore to Mount Gunson towards the N., and southward at Woocalla, and in cuttings along the East-West railway line.

The dolomite is ferruginous, and of a brown color, and the appearance of the soil, of the same characteristic brownish color, indicates the existence of the dolomite where the rock itself is hidden. The weathered surface of the rock assumes a peculiar contorted and wavy appearance, and the mass is strongly jointed, the main jointing mostly approximating a N.W.-S.E. direction, though at a place N.E. of the cutting on M.S. 1143, the main jointing was E.-W.

Everywhere that the dolomite was seen it showed the presence of manganese, from mere specks and dendritic markings up to appreciable quantities. In some places the solid dolomite outcrops as a more or less flat sheet without any cover; in others it rises slightly above the level of the lake as low rounded ridges, and again it is covered by soil, varying in depth from 15ft. around the edges of the lake, to a few inches of silt in the bed of the lake.

The ore deposits occur as segregations in the residual clay, resulting from the decomposition of the impure manganiferous and ferruginous dolomite.

The arm of the lagoon is, like the main lagoon, dry on the surface, which is mostly covered with a shallow deposit of saline mud, the water lying from a few inches to several feet below the surface.

Taken from the S.E. to the N.W., a brief description of the claims and leases is as follows:—

M.C. 11162, at the S.E. extremity, lies parallel with the shore of the small inlet from the Pernatty Lagoon, this shore being about midway along the claim. The N.E. half of the claim consists of low hills, covered with quartzite gibbers, separating the small arm from the main lagoon.

The S.W. half of the claim shows a low dolomite outcropping, parallel to the shore of the arm of the small lagoon, the remaining portion extending out over the lagoon surface.

The most extensive workings here are those known as the Tributors' Workings, which are near the middle of the W. boundary of the claim, in the lake bed. From here some small workings and pits follow the shore of the lake (which is nearly E.-W.), lying in the narrow strip of lake bounded on the S. side by the dolomite ridge. Towards the E. end of the claim some pits have been sunk in a small sandy gully off the lake, and show the presence of good ore.

McGregor's Lake Workings on M.C. 11116 are close to the E. end of this claim, and form a continuation of the workings.

M.S. 1134 lies almost wholly in the lake bed, with the exception of a dolomite ridge, which occupies a portion of its N.E. end. There are no

productive workings on this lease, although a large number of prospecting holes laid out at two-chain intervals have been sunk in the lake bed on the S.W. portion. These holes are for the most part very shallow, and do not give much information, with the exception of one or two which have been deepened, near the S.W. boundary. Almost on this boundary are some workings showing ore, belonging to the South Extended Syndicate.

M.S. 1136 includes a considerable number of workings. The shore of the lake lies close to and parallel with its N.E. boundary, and the central portion of the block is occupied by a low ridge of dolomite. Between the ridge and the shore a line of workings extends in a N.W.-S.E. direction for nearly the length of the block, and on the S.W. side of the dolomite ridge are an extensive series of workings, known as the Lake Workings, which extend also into M.S. 1135.

In the N. corner are the first of the barytes workings, a number of pits from which good crystalline barytes has been obtained and sold.

M.S. 1135. The W. half of this block lies beyond the lake bed, and includes hills covered with quartzite and ironstone gibbers, while the E. portion is occupied by lake bed.

The lake workings extend into this block towards the E. corner, and N. from this some prospecting holes have been sunk systematically, but are too shallow to afford much information.

M.S. 1137. The surface here consists partly of lake bed and partly of a low dolomite ridge, and on the E. boundary the section extends beyond the shore of the lagoon over hills strewn with quartzite fragments. The lower half of the block contains numerous workings, those known as the "Washer" quarries lying near the S. corner, while N.E. from these are other workings, from which manganese and barytes have been obtained. Farther to the N.E. again, on the rising ground beyond the shore of the lake, are some other workings which show good manganese ore. The salt pans are also situated on this block.

M.S. 1138. The N.W. extremity of the lake extends along the N.E. portion of this block, but three-quarters of the section lies beyond the lake shore on low rounded elevations covered with quartzite and ironstone rubble.

Some of the most important workings occur here, consisting of the Big Quarry, the Nos. 1 and 2 Magazine Quarries, and the Blue Quarry, and both in the extraction of ore and in prospecting, a considerable amount of work has been done.

The main workings are towards the S.E. corner, but the presence of manganese is shown in various prospecting pits, extending up to the N.W. boundary.

The workings on this block are almost wholly above the lake bed, on the surrounding shore.

M.S. 1139. This block extends to the N.W., beyond the branch of the main lagoon, and includes low hills covered with quartzite and ironstone fragments, sloping down to a shallow creek near the centre of the block. The only workings occur beside this creek, near the boundary of M.S. 1138, where some manganese ore is exposed.

M.S. 1140 and 1141 comprise low-lying quartzite and ironstone strewn ground, upon which no work has as yet been done.

M.C. 11155 adjoins the S.W. boundary of M.S. 1141, and consists of low, hilly country, covered with quartzite and ironstone fragments. Very little

work has been done on it, with the exception of some prospecting holes close to the boundary of M.S. 1141, which show good ore.

M.S. 1142 is on low country, strewn with quartzite and ironstone rubble, and showing outcroppings of dolomite. No work has been done here with the exception of one prospecting hole, which shows good manganese ore.

M.S. 1143 is the last block at the N.W. end. It comprises the greater part of a small lake, another branch from the main Pernatty Lagoon, and also a considerable extent of high country around the shores of this branch.

The higher ground is, as elsewhere, covered with quartzite fragments, and two small mounds in the lake bed show a capping of conglomerate.

About the centre of the lease, just above the edge of the lake bed, are some pits which disclose the presence of good ore. The main working is known as the Big Cutting, and extends into the hill for some distance, while in the lake bed itself manganese ore can be seen in several prospecting holes, and also outcropping in different places.

Detailed Description of Principal Workings of M.S. 1138.

The Big Quarry.—This is an irregular open cutting, roughly about 2½ chains by 1¼ chains, situated near the end of a small arm of the lake bed. The depth of the cut varies from 6ft. to 4½ft., the bottom being level, and the depth having been determined by the water level at the time of working.

At the E. end of the cut a pit has been sunk in the bottom to a depth of 4ft.

The manganese ore here occurs in two forms, as a soft blue ore, and as a harder and darker variety, showing a considerable amount of pyrolusite crystals, and these ores occur either as comparatively solid faces or as masses and nodules of different sizes in the residual clay, resulting from the decomposition of the dolomite.

Decomposed sandstone also shows in places, but was not seen anywhere to contain any ore.

In one place on the S. face of the quarry there is an exposure of nearly solid, hard ore, 6ft. high, with practically no overburden, and this ore can be seen on the surface extending some distance S.E. from the cut.

A sample taken from here over the 6ft. face, as it stands, assayed as follows:—

Sample No. 24—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
43.40	4.05	6.92	0.05	0.44

At the S.W. corner of the quarry there is a fairly solid face of nearly 4ft. thickness of good blue ore of softer nature.

Sample No. 25 was taken from a face of 39in. of ore at this point, and assayed as follows:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
48.96	1.57	7.33	0.02	0.55

The point of ground extending into the cut from the N.W. shows from 2ft. to 4ft. of more or less solid ore in the residual clay.

The rest of the cutting shows different amounts of ore as nodules and masses in the residual clay, and the floor of the cut appears to be mostly in ore.

The pit, which has been sunk 4ft. below this bottom, also shows good solid ore to the bottom, and sample No. 47 taken from here is as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
56.03	2.14	1.31	0.05	less than 0.01

Some ironstone shows in places in the quarry, and the over burden ranges in thickness from nothing to several feet. A sample was taken from all the ore exposures in this cutting, and is as follows:—

Sample No. 5

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
48.11	3.15	4.39	0.06	0.24

As showing to what extent the ore can be beneficiated by simple dressing and washing by hand, a sample was taken from 26 bags of dressed ore from this quarry, the analysis of which is as follows:—

Sample No. 4—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
55.04	0.67	2.99	0.03	0.07

Another sample, representing 40 bags of ore from the waterhole in the quarry, dressed and washed, is as follows:—

Sample No. 62—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
51.50	0.90	0.49	0.04	less than 0.01

Another sample of ore from the W. side of this quarry, representing about 80 bags, dressed but not washed, is as follows:—

Sample No. 67—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
55.2	0.90	3.30	0.02	0.17

The Blue Quarry, situated half a chain S.W. from the Big Quarry, is three-quarters of a chain by a quarter of a chain in size, and 4ft. to 5ft. in depth.

The ore is a soft blue variety, which can be dressed, but is rather soft and fine for the ordinary hand-washing.

This cutting is on higher ground, above the level of the lake, and the ore lies beneath a cover of soil from 1½ft. to 2ft. in depth.

The ore occurs as masses and bunches in the residual clay, from which it must be sorted and dressed to remove the adhering waste.

A pit has been sunk from the bottom of the cutting to a depth of 4ft., and shows good ore to the bottom.

Samples were taken, representing the ore as roughly sorted during mining, the first of which, taken from the ore exposure above the pit, is as follows:—

Sample No. 22—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
49.52	0.45	7.54	0.05	0.40

The next sample, taken from the pit over a depth of 4ft., is taken over the face as it stands:—

Sample No. 26—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
42.73	3.38	13.09	0.04	0.81

The next sample was taken from the same place as No. 22, but was taken over the face as it stood, including the residual clay, and is as follows:—

Sample No. 21—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
39.48	2.47	11.35	0.04	0.67

This sample was taken to give an idea of the value of the face as it stands.

No. 1 Magazine Quarry, situated 2½ chains S.E. from the Blue Quarry, is 50ft. long, with a greatest width of 31ft. and a race 6ft. high at the deepest part, and is also on high ground above the lake bed. At the deepest end the face shows 2ft. of overburden, below which there is 4ft. of ore in the residual clay. The ore is mostly of the soft blue high-grade variety, but in places on the S. side it appears to be harder.

In order to gain an idea of the amount of manganese ore showing in the face a composite sample was obtained from a number of strip samples taken from the lower 4ft. of the face, excluding the overburden, and the analysis was as follows:—

Sample No. 23, face 4ft. deep of ore, mixed with clay and decomposed dolomite, as standing:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
40.75	8.67	5.14	0.06	0.34

Sample No. 37 represents dressed and bagged ore from this quarry, as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
46.41	4.16	4.38	0.05	0.39

No. 2 Magazine Quarry, situated on high ground about one chain from the edge of the lagoon, and 1½ chains E. from No. 1 Magazine Quarry, is an irregular cutting 74ft. long, with a maximum width of 20ft. and depth of 10¼ft., which was about water level at the time of inspection. At one point a pit has been sunk 4ft. below the bottom, and shows good hard ore going down. There is 2ft. of overburden to be removed, below which is 4½ft. of residual clay, containing a certain amount of soft blue ore of good quality, and beneath this is 3¾ft. of clay, containing some fairly hard good quality ore, while the bottom of the cutting shows good ore, mixed with a little clay.

A composite sample made up from a number of strip samples taken over the lower 3¾ft. of the face of ore and clay at the deep end of the cutting, yielded as follows:—

Sample No. 44—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
34.52	11.82	9.22	0.06	0.56

Samples 43 and 58 (combined), representing ore bagged from this quarry, after dressing and washing, yielded as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
56.17	0.67	1.48	0.06	0.18

A sample was also taken from the ore exposed in the pit sunk below water level in this quarry, and assayed as follows:—

Sample No. 59—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
50.51	2.47	2.18	0.05	less than 0.01

Around these main quarries, and extending N.W. along and above the shore of the lake, are a number of prospecting holes sunk to various depths, and disclosing the existence of a large quantity of ore of fine quality, mostly of the softer blue variety, and for convenience of reference these holes are numbered on the plan.

Pit No. 1, to the N. of No. 2 Magazine Quarry, situated a little above the edge of the lake, is only 2½ft. deep, with 6in. of overburden. A certain amount of ore shows here, but the hole is not deep enough. A sample was taken of the ore as it would be roughly sorted during breaking, and is as follows:—

Sample No. 27, from 2ft. depth of face—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
46.41	8.23	2.56	0.10	less than 0.01

Pit No. 2, about two chains E. by N. from No. 1 Magazine Quarry, shows 3ft. of overburden, then 2ft. of soft blue ore and residual clay, with ironstone showing in the bottom. It is possible that ore may be found below this ironstone, as was seen to be the case in other excavations. This hole is on high ground, being one of the highest in the vicinity.

Sample No. 2, taken here from 2ft. depth of face, represents the ore as roughly sorted during mining, and yielded as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
45.42	2.93	11.67	0.06	0.64

Pit No. 4, a little E. of the mouth of the Blue Quarry, shows 1ft. 8in. of overburden, then 6ft. 2in. of good, rather soft blue ore, fairly intimately mixed in the residual clay. Sample No. 1, taken over 6ft. 2in. face as a strip sample, including clay and ore:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
44.99	2.36	6.43	0.05	0.44

Sample No. 42, taken over 6ft. 2in. face, representing ore as roughly sorted during mining:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
53.77	1.35	3.61	0.05	0.11

Pit No. 5, near the S.W. corner of the Big Quarry, shows 1ft. of overburden, below which is 9ft. 4in. of good blue ore of soft nature, mixed with a small amount of residual clay.

Sample No. 15, representing the ore as roughly sorted during mining, taken over a face of 9ft. 4in.:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
48.81	1.57	2.94	0.20	0.06

Pit No. 6, about half a chain S. of the E. end of the Big Quarry, is 7ft. deep. There is no overburden, the ore outcropping on the surface, and extending back to the near edge of the Big Quarry. The ore is hard, and easily sorted and washed, and a sample taken, representing the ore as roughly sorted during mining, gave the following result:—

Sample No. 3, taken over a face of 7ft.—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
44.99	5.63	2.26	0.09	less than 0.01

Pit No. 7, a little W. of the S.W. corner of the Big Quarry, is 5ft. deep, with 2½ft. of overburden, below which is residual clay, with a certain amount of soft blue ore, represented as roughly sorted by the following sample:—

Sample No. 56—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
49.52	0.22	3.27	0.03	0.64

Pit No. 8, a little E. of the Big Quarry, 22ft. long and 12ft. across the widest place, shows 3in. of overburden, followed by 3½ft. of hard blue ore, intermingled with residual clay, a good deal of pyrolusite crystals showing with the ore, while a small hole in the bottom also shows some solid ore.

Sample No. 63, representing ore as roughly sorted during mining from a face of 3½ft., was as follows:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
50.90	2.36	2.61	0.06	less than 0.01

Pit No. 9, a little W. of the Big Quarry, shows 2ft. of overburden, followed by 5ft. of good soft blue ore in residual clay.

Pit No. 10, a little S.W. from No. 9, shows 18in. overburden and 4ft. of residual clay, containing good blue ore. A composite sample, representing the ore as sorted during mining, was taken from these holes, and yielded as follows:—

Sample No. 12, depth of face 5 ft.—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
44.71	4.39	13.92	0.03	1.57

Pit No. 11, about two chains W. of No. 9, is about 6ft. deep, and shows 2½ft. of overburden and a bar of ironstone, below which is some good blue ore of a harder nature, with ironstone showing in the bottom again.

Pit No. 12 shows 2½ft. overburden, 3ft. of ore in clay, and ironstone in the bottom.

Pit No. 13 shows 2ft. overburden and 2½ft. of soft blue ore in dolomitic clay, with ironstone in the bottom.

Pit No. 18 shows 2½ft. overburden, followed by 6ft. of dolomitic clay and soft blue ore.

Pit No. 19 has 1½ft. overburden and 3ft. of soft blue ore intermixed with dolomitic clay.

Pit No. 15 shows 15in. overburden and 2ft. of decomposed dolomite, containing rather finely disseminated soft blue ore.

A composite sample of the ore as roughly sorted during mining from these holes is as follows:—

Sample No. 7, representing pits 11, 12, 13, 15, 18, and 19—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
42.16	6.87	10.21	0.03	0.48

Pit No. 14 shows 2ft. of overburden, then 8½ft. of soft blue ore of high grade, intermixed with the residual clay. The ore here is rather finely disseminated through the clay. Sample No. 10 from here represents the ore as roughly sorted in mining, and is as follows, over an 8½ft. face:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
45.42	1.35	11.19	0.06	0.33

Pit No. 21, a little E. of No. 14, shows 18in. of overburden, followed by 3½ft. of soft blue ore in decomposed dolomite, with ironstone and a little ore showing in the bottom.

From this hole a line of holes extends out to No. 20. The first of these shows 15in. overburden and 4ft. of dolomitic clay, containing soft blue ore. The next has 18in. overburden, with similar ore in clay to a depth of 4ft., and ironstone showing in the bottom. Next to this is a hole with 2ft. of ore in clay beneath 18in. overburden; the next hole and the last, No. 20, are shallow, and show no ore. A composite sample of the ore from this line of holes is as follows:—

Sample No. 6—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
45.28	3.26	8.58	0.06	0.18

A bar of ironstone appears to be rising in these holes from W. to E., and it should be sunk on to see if possibly there may be ore beneath it, as noticed in other pits.

Pit No. 17, to the N. of No. 16, shows 2ft. of overburden, and ironstone beneath, no ore being visible.

This hole might also be deepened for the same reason.

A line of shallow pits extends for eight chains N.E. from No. 17, and shows only ironstone with traces of ore beneath the overburden. These could also be investigated to see if there were ore beneath the ironstone.

Pit No. 23, a few feet from the N.W. corner of the Big Quarry, shows 6in. of overburden and 6ft. of ore in the residual clay. The ore is of good quality, occurring as hard nodules, easily sorted, and the bottom shows a mixture of ore and ferruginous material. Some of the ore shows a good deal of pyrolusite in crystalline form.

A sample from here of the ore as sorted in mining is as follows:—

Sample No. 48, taken over a 6ft. face—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
51.64	2.59	2.70	0.05	0.18

Detailed Description of Principal Workings on M.S. 1137.

Line of trenches, Nos. 25 and 26, of which No. 24, on M.S. 1138, is a continuation. These are a little E. of the Big Quarry, and extend for four and a half chains in a N.E. direction, and are almost wholly in the lake bed, while at the N.E. end they abut against a low dolomite ridge.

The average depth of these trenches is 3ft., with a few inches of water in the bottom, and they show ore in the form of nodules and aggregations in the residual clay, with the exception of No. 24, which is just above the lake bed, and shows 9in. of overburden and 4ft. of residual clay with traces of manganese. Possibly this trench requires deepening, when ore might be found below.

No. 25 trench shows the most ore, the E. end of No. 26 trench showing undecomposed dolomite rising in the bottom towards the ridge.

A composite sample of the ore from these trenches, representing the ore as roughly sorted during mining, was as follows:—

Sample No. 20—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
50.50	3.42	3.51	0.05	0.13

Pit No. 27, S. of No. 26, is in the lake bed, and was full of water to within 1ft. of the top. Good blue ore in hard lumps and nodules occurs here in the residual clay, and can be easily sorted and dressed. For several chains around, manganese ore and manganiferous dolomite can be seen outcropping.

A sample of the ore as sorted during mining was obtained from the ore showing above the water, and was as follows:—

Sample No. 49—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
49.81	4.08	2.19	0.05	0.12

Trench No. 28, two chains N. of the long line of trenches, is one and a half chains in length. The W. end of this trench is in decomposed sandstone, the remainder is in more or less decomposed dolomite, with ore occurring in it in hard masses and nodules. Dolomite showing more or less ore extends between here and the long line of trenches, and the dolomite ridge rises from the E. end of the trench.

Sample No. 66 from here represents the ore as sorted during mining, and is as follows:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
52.99	2.76	2.52	0.05	0.10

Trench No. 29, still farther N., is 33ft. long and 1½ft. deep, without any overburden, and shows hard nodular ore, that can be easily sorted and dressed, in the residual clay. The E. end of the trench abuts against the dolomite ridge.

Sample No. 11, taken from here, represents the ore as sorted during mining, and is as follows:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
54.09	2.64	2.58	0.08	0.10

The Washer Quarries are situated six chains from the S. corner of M.C. 1137, the largest excavation having a maximum width of 59ft. and length of 67ft., close beside which, on the E. side, is another excavation 56ft. long and 16ft. wide. They are at the S. end of the dolomite ridge, which extends to the N., and on which the salt pans are situated.

The large cutting is 4ft. 9in. deep, this being about water level at the time.

Undecomposed dolomite can be seen in the bottom in several places, and on the E. side of the quarry rises to within 2ft. of the surface.

Above the dolomite is residual clay containing masses and nodules of ore, with pyrolusite in crystalline form. The masses of ore are mostly of rounded form, and exhibit concentric structure.

A small hole in one place in the bottom shows ore going down for another foot in depth.

A sample from the larger quarry representing the ore as roughly sorted, is as follows:—

Sample No. 19—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
51.19	2.54	6.78	0.05	0.12

Sample No. 41, taken similarly from the smaller quarry adjoining, is as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
48.99	3.20	9.40	0.05	0.06

A sample was taken from 17 bags of dressed and washed ore from the Washer Quarries, and the analysis is as under:—

Sample No. 65—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
52.85	3.53	3.99	0.07	0.10

Trench No. 30, near the N. end of a small arm of the lake, lies between dolomite ridges extending on both sides and to the N. It is a shallow trench nearly a chain long, and shows a limited amount of good ore in the residual clay, associated with more or less decomposed dolomite.

Sample No. 40, from here, representing the ore as sorted during mining, is as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
49.12	3.98	3.12	0.04	0.21

Pit No. 31 is six and a half chains N. of E. from Trench No. 30, and is 6ft. deep. The sides show decomposed sandstone and residual clay, the latter containing a small amount of ore of soft blue variety. The pits in the vicinity also show a little ore, the whole group being situated in more or less undecomposed dolomite, which shows the presence of different amounts of manganese.

Sample No. 69 from here shows the quality of the ore to be obtained by sorting during mining, as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
47.47	2.10	6.43	0.06	0.20

Trench No. 32 is about one and half chains long, and lies E. of the Washer Quarry, in the lake bed. Ore has been extracted from here, and the waste has been filled back into the trench, and some ore could be seen in the sides of the trench in residual clay, and associated in places with undecomposed dolomite and ironstone. The ore occurrence in pit No. 32 is similar, and more or less manganiferous dolomite can be seen outcropping around these trenches.

A general sample was taken from these trenches, representing the ore as sorted during mining, and yielded as follows:—

Sample No. 34—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
52.16	3.53	1.70	0.08	0.11

Pit No. 34, about two and a half chains N. of the Washer Quarries, is situated on a dolomite ridge, and shows manganiferous dolomite and a little blue ore.

Detailed Description of Workings on M.S. 1136.

A large part of the central area of this section is occupied by a low ridge of dolomite, whose longer axis lies N. of W., the ridge coming in from M.S. 1134, and extending nearly to the southerly boundary of M.S. 1137. The workings form two groups, one lying along the N.E. side of the ridge in a narrow arm of the lake, and the other extending in a general N.-S. direction on the other side of the ridge into M.S. 1135, and known as the Lake Workings, being situated in a wide expanse of lake bed. On the N.E. side of the section the lake shore is approximately parallel to the boundary and from one chain to two and a half chains within it.

Pit No. 35 is said to be the spot where manganese ore was first obtained by the discoverer, and the ore here appears to contain more iron than elsewhere.

A long line of workings extends from pit No. 36 to pit No. 37, a total distance of nine chains, and lies in the lake bed parallel to the edge of the dolomite ridge, which in places forms the boundary on the S.W. side of the trenches.

These cuttings have an average depth of 3ft., and show good blue ore occurring in lumps and nodules in the residual clay. Undecomposed dolomite can be seen in many places forming the boundary of the ore deposits on the S.W. side, and presents a rounded and water-worn appearance, due to solution proceeding along the jointing planes.

A composite sample was taken from these trenches, representing the ore as roughly sorted during mining operations, and yielded as follows:—

Sample No. 38—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
48.14	6.08	3.10	0.05	0.09

Another extensive set of workings commences 4½ chains E. of No. 37, occupying a narrow strip of lake bed between the shore and the dolomite ridge. The cuttings are 3ft. to 4½ft. deep, and the occurrence of ore is similar to that in the line from No. 36 to No. 37, just described.

The extent of these workings from No. 38 cutting to No. 42 cutting is a little over seven chains, the general direction of the workings being S.E.

A composite sample taken from the Nos. 38 and 39 cuttings, representing the ore as roughly sorted, is as follows:—

Sample No. 18—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
49.50	6.18	1.78	0.04	0.05

No. 38 cutting is 43ft. long and No. 39 cutting is 182ft. long, with a maximum width of 24ft.

No. 40 cutting is 91ft. long, with a maximum width of 25ft.; No. 41 is 86ft. long, with maximum width of 21ft.

A composite sample was taken from Nos. 40 and 41 cuttings, representing the ore as roughly sorted during mining, and yielded as follows:—

Sample No. 17—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
51.13	4.03	1.89	0.04	0.06

No. 42 cutting is a little more than two chains S.E. from No. 40. Between these two cuttings are a number of other workings, the average depth of the lot being about 3½ft. The ore appears somewhat more ferruginous, occurring, as elsewhere, as masses and nodules in the residual clay. Some iron is present as limonite in irregular vughs and cavities in the ore, and a considerable amount of this could be removed by breaking and washing the ore.

A composite sample taken from No. 42 cutting and the pits between it and Nos. 40 and 41, representing the ore as roughly sorted, yielded as follows:—

Sample No. 52—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
51.81	4.64	1.26	0.04	0.06

Pit No. 50, about 1½ chains N.E. of No. 38 cutting, shows ore, as also does pit No. 51, N.W. of No. 38 cutting.

A pit, No. 52, which is on the dolomite ridge about 1½ chains S.W. from No. 38, shows manganiferous dolomite, and a couple of pits, Nos. 53 and 54, near the southernmost barytes workings, show good manganese ore.

Towards the W. corner of the section is another group of workings in the lake bed, known as the Lake workings. The largest of the excavations is one about a chain in diameter, No. 45. From these workings ore has been obtained, occurring as irregular segregations in the residual clay, and was seen in places to be bounded by undecomposed and massive dolomite, with some decomposed sandstone showing in places.

The line of workings between and including pits Nos. 43 and 44 were sampled as a group, the analysis being as follows:—

Sample No. 46, representing the ore as roughly sorted during mining—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
46.51	8.95	1.47	0.06	0.06

The ore is in hard lumps and nodules of fair size, and can be easily sorted and dressed.

The workings Nos. 45, 46, 47, 48 show similar occurrences of ore, and were sampled as a group, with the following result, the sample representing the ore as sorted during mining:—

Sample No. 55—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
50.86	2.87	1.77	0.05	0.08

Mineral Section 1135.

Close to the common boundary of this section, and section 1136. is a large excavation, No. 55. which shows a certain amount of good blue ore, part as small irregular lumps, and part finely disseminated. Dolomite, more or less manganiferous, can be seen in and around this cutting, which is about 3ft. deep.

Sample No. 32, taken from here, and representing the ore as sorted during mining, is as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
45.10	3.54	2.79	0.06	0.24

Two cuttings a little S. of this are No. 56 and No. 57, each about 3ft. deep, the former being 118ft., and the latter 66ft., in length, and the ore here is similar to that occurring at No. 55 cutting, some of it being finely disseminated in the residual clay.

Sample No. 14 from these cuttings, representing the ore as sorted during mining, is as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
49.78	4.09	1.91	0.08	0.13

Some pits E. and W. from No. 56 show manganiferous dolomite, with irregular distribution of ore.

A large cutting, No. 49, on the boundary of mineral sections 1135 and 1136, was sampled, the assay being as under:—

Sample No. 28, representing the ore as sorted during mining—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
51.70	3.10	1.36	0.07	0.20

Mineral Section No. 1139.

Very little work has been done here, there being only a few cuttings near the N. boundary of M.S. 1138. Two of these, at No. 58, are shallow excavations, the larger being about 22ft. square, and show ore occurring beneath 2ft. of overburden. There is some good blue ore, and some which is more or less ferruginous and dolomitic, the ore itself being hard and easily sorted.

A sample was obtained from these pits and from some trenches at No. 22, where similar ore shows, and yielded as follows:—

Sample No. 45—

Insoluble Matter.	Manganese Dioxide.	Manganous Oxide.	Ferric Oxide.	Phosphoric Anhydride.	Sulphur Trioxide.	Barium Oxide.	Total Manganese.	Total Iron.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
2·99	78·08	0·85	8·04	0·16	under 0·02	0·70	49·95	5·63	0·07	under 0·01

A pit sunk at No. 59, between Nos. 58 and 22, shows 2ft. overburden, followed by 3½ft. of residual clay, with a little ore.

Sample No. 57 from here yielded as follows:—

Insoluble Matter.	Manganese Dioxide.	Manganous Oxide.	Ferric Oxide.	Phosphoric Anhydride	Sulphur Trioxide.	Barium Oxide.	Total Manganese.	Total Iron.	Phosphorus.	Sulphur.
Per cent	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent	Per cent.	Per cent.	Per cent.
3·43	78·30	1·03	6·11	0.16	0·10	0·90	50·23	4·28	0·07	0·04

Detailed Description of Workings on M.S. 1143.

This is the last block, lying at the N.W. extremity of the group of leases, the principal working on which is near the centre of the lease.

Portion of the lease is occupied by a small inlet from the main Pernatty Lagoon, and ore occurs in this small arm, and also on the higher ground on the N. shore of the arm. The main working, No. 60, is known as the Big Cutting, and is situated on the N. bank of the inlet, on a hill about 40ft. above the lake level. This cutting has been extended into the hill for a distance of two chains, the width being from 10ft. to 20ft., the deepest face being about 15ft. in depth.

The sides of this cutting show overburden with quartzite pebbles, below which is residual clay and decomposed sandstone, the clay carrying small amounts of manganese, irregularly distributed. At two chains in from the entrance ore begins to appear in more solid masses, the face at the end showing loam and quartzite pebbles at the top, followed by 6½ft. of more or less solid ore, beneath which, to the bottom of the cut, is 4½ft. of decomposed ferruginous dolomite, containing irregular lumps and nodules of ore.

Undecomposed dolomite can be seen in the bottom of the cutting in various places.

A general sample was taken from the 6½ft. band in the face at the end of the cutting, and yielded as follows:—

Sample No. 29, taken over 6½ft. depth of face—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
52.99	2.94	1.38	0.06	0.05

At the end of the cutting there is a trench, No. 61, a few feet deep, and a hole sunk in this shows 4ft. of solid ore, similar in appearance to the above, and below which is 2ft. of dolomite, partially decomposed and carrying a little ore through it.

From this trench another, No. 62, extends in a northerly direction for 85ft., where it connects with a trench 18ft. long.

These trenches show ore, some of which is in the form of small pebbles or rubble in the gypseous overburden, the remainder appearing as segregations in the residual clay, a thickness of 18in. of clay and ore showing in places beneath the overburden, to the bottom of the trench.

A sample was taken from the exposures in these northerly trenches, representing the ore as sorted during mining, and yielded as follows:—

Sample No. 36—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
50.92	4.26	1.87	0.05	0.23

On the E. side of the main cutting is a trench, No. 64, about a chain long. The upper 2ft. is gypseous clay, with manganese nodules, which shows along the greater part of the trench. A pit has been sunk to a depth of 10ft. in this trench, and exposes a thickness of 10ft. of ore in residual clay.

Sample No. 54 represents the ore as sorted during mining, from the exposures in the trench and from the first 4ft. of the pit, and yielded as follows:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
50.23	5.68	3.11	0.04	0.19

A sample was taken from the bottom 6ft. of the pit of the ore as sorted during mining, and is as follows:—

Sample No. 33—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
49.68	7.82	1.28	0.05	less than 0.01

To the N. of this trench is a pit, No. 63, which shows 2½ft. of gypseous clay with nodules of manganese, followed by 2½ft. of ferruginous dolomite more or less decomposed, with a limited amount of ore through it.

Sample No. 60, representing the ore as sorted during mining, was obtained from this exposure, and is as follows:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
37.26	14.62	2.29	0.05	0.63

To the N.W. of the No. 62 trench are some holes which show ore as nodules in gypseous clay and in segregations in the residual clay beneath.

About these workings manganese ore appears in considerable amount on the surface and in the overburden, as nodules set free by the weathering and decomposition of the dolomite.

This manganese rubble forms a good guide to the presence of ore beneath, and occurs over a considerable area on the E. side of the main workings, but very little shows to the W.

At No. 67 there are a couple of pits, of which the N. one is 6ft. deep to water level, and exposes ore occurring in large masses in decomposed ferruginous dolomite.

The ore here would be easily sorted, and a sample representing the roughly sorted ore was obtained, which yielded as follows:—

Sample No. 31—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
49.95	5.98	1.11	0.06	0.01

These pits are in the bed of the small inlet from the main lake. Some manganese ore also shows at No. 65 pit, about four chains E. of the big cutting dump, and more or less manganiferous dolomite can be seen in several places in the lake bed.

On this section there is a considerable amount of gypsum associated with the ore.

At pit No. 66 a sample was taken of the ore showing, the analysis of which is as follows:—

Sample No. 39—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
51.88	4.84	1.19	0.06	less than 0.01

On M.S. 1142 there is only one pit sunk, and this, which is 2ft. deep, shows hard, massive ore without overburden. Dolomite can be seen outcropping practically all around this hole.

A sample was taken, representing the ore as roughly sorted during mining, and yielded as follows:—

Sample No. 68—

Insoluble matter.	Manganese Dioxide.	Manganous Oxide.	Ferric Oxide.	Phosphoric Anhydride.	Sulphur Trioxide.	Barium Oxide.	Total Manganese.	Total Iron.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
4·69	69·20	1·50	4·50	0·16	0·55	0·06	44·85	3·15	0·07	0·22

No work has been done on M.S. Nos. 1141 and 1140.

Mineral Claim No. 11155.

Adjoins the N.W. boundary of M.S. 1141. A little prospecting work has been done here, a few holes having been sunk, which show the presence of manganese ore. There is a covering of 9in. of soil, with quartzite pebbles and manganese shoad stones, below which can be seen 2½ft. of fairly solid ore.

A sample was taken representing the ore as roughly sorted during mining, and yielded as follows:—

Sample No. 64, taken at pit No. 68—

Insoluble Matter.	Manganese Dioxide.	Manganous Oxide.	Ferric Oxide.	Phosphoric Anhydride.	Sulphur Trioxide.	Barium Oxide.	Total Manganese.	Total Iron.	Phosphorus	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
4·29	79·34	1·10	2·41	0·43	0·17	0·68	50·94	1·69	0·19	0·07

Mineral Claim No. 11162.

This claim is situated at the S.E. corner of M.S. 1134, and the lake shore extends down the centre of the claim.

The workings are situated on a narrow strip of lake bed between the shore and a low ridge of dolomite, extending N.W. and S.E., approximately parallel to the shore of the lake.

The workings known as the Tributors' workings are near the N.W. boundary of the claim, close to the corner of M.S. 1134.

The workings at No. 69 consist of a large excavation nearly a chain long, and some smaller pits.

The ore occurs as masses and nodules in residual clay and partly decomposed dolomite.

A sample was taken representing the ore as roughly sorted during mining, and yielded as follows:—

Sample No. 50—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
51.33	3.66	1.93	0.06	0.17

Married Men's Houses—Iron Knob and Hummock Hill—
Galvanized Iron (an intermediate stage).

Married Men's Houses—Iron Knob and Hummock Hill - Reinforced
Concrete (type now constructed).

Face p. 80.]

The pits at No. 70, to the S.E., show a similar deposit, the workings also lying between the dolomite ridge and the shore. The ore here is more or less cellular, the cavities containing loose, powdery limonite, which could be got rid of to a large extent by breaking the ore and washing it. A sample was taken representing the ore as roughly sorted during mining, and is as follows:—

Sample No. 13—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
52.71	3.42	0.90	0.07	less than 0.01

A sample was taken from 70 bags of dressed ore at these workings at Nos. 60 and 70, of which the analysis is as follows:—

Samples Nos. 35 and 51 (composite)—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
56.85	2.32	0.83	0.06	less than 0.01

Following along the shore of the lake inlet are a number of prospecting holes, showing the presence of manganese at Nos. 72, 73, &c.

At No. 71, situated in a small gully in the sand hills above the shore, are a couple of small pits, which show good ore. In one hole there is 3½ft. of residual clay, containing good blue ore of a soft nature disseminated through the clay in lumps of various size.

The ore as roughly sorted during mining is represented by sample No. 53, which is as follows:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
55.47	1.76	2.62	0.08	less than 0.01

TABLE OF ANALYSES OF SAMPLES.

Analyses by W. S. Chapman.

M. S. 1136.

Sample No.	Insoluble Matter.	Manganese Dioxide.	Manganous Oxide.	Ferric Oxide.	Phosphoric Anhydride.	Sulphur Trioxide.	Barium Oxide.	Total Manganese	Total Iron.	Phosphorus.	Sulphur.
	%	%	%	%	%	%	%	%	%	%	%
17	1·89	—	—	—	—	—	—	51·13	4·03	0·04	0·06
18	1·78	—	—	—	—	—	—	49·50	6·18	0·04	0·05
38	3·10	—	—	—	—	—	—	48·14	6·06	0·05	0·09
46	1·47	—	—	—	—	—	—	46·51	8·95	0·06	0·06
52	1·26	—	—	—	—	—	—	51·81	4·64	0·04	0·06
55	1·77	—	—	—	—	—	—	50·86	2·87	0·05	0·08
From the above samples a composite sample, No. 70, was obtained, the analysis of which is as under :—											
70	1·91	77·76	0·72	7·88	0·11	0·18	0·36	49·72	5·52	0·05	0·07
M. S. 1137.											
19	6·78	—	—	—	—	—	—	51·19	2·54	0·05	0·12
41	9·40	—	—	—	—	—	—	48·99	3·20	0·05	0·06
40	3·12	—	—	—	—	—	—	49·12	3·98	0·04	0·21
69	6·43	—	—	—	—	—	—	47·47	2·10	0·06	0·20
49	2·19	—	—	—	—	—	—	49·81	4·08	0·05	0·12
66	2·52	—	—	—	—	—	—	52·99	2·76	0·05	0·10
20	3·51	—	—	—	—	—	—	50·50	3·42	0·05	0·13
11	2·58	—	—	—	—	—	—	54·09	2·64	0·08	0·10
34	1·70	—	—	—	—	—	—	52·16	3·53	0·08	0·11
65	3·99	—	—	—	—	—	—	52·85	3·53	0·07	0·10

TABLE OF ANALYSES OF SAMPLES—*continued.*

Sample No.	Insoluble Matter.	Manganese Di-oxide.	Manganous Oxide.	Ferric Oxide.	Phosphoric Anhydride.	Sulphur Tri-oxide.	Barium Oxide.	Total Manganese.	Total Iron.	Phosphorus.	Sulphur.
	%	%	%	%	%	%	%	%	%	%	%
M. S. 1136.											
From the preceeding samples a composite sample, No. 71, was obtained, the analysis of which is as under :—											
71	4·24	79·50	1·30	4·57	0·11	0·33	0·46	51·47	3·20	0·05	0·13
M. S. 1135.											
28	1·36	—	—	—	—	—	—	51·70	3·10	0·07	0·20
32	2·79	—	—	—	—	—	—	45·10	3·54	0·06	0·24
14	1·91	—	—	—	—	—	—	49·78	4·09	0·08	0·13
From the above samples a composite sample, No. 72, was obtained, the analysis of which is as under :—											
72	1·98	79·52	0·28	5·06	0·15	0·50	0·43	50·46	3·54	0·06	0·20
M. S. 1138.											
27	2·56	—	—	—	—	—	—	46·41	8·23	0·10	less than 0·01
1	6·43	—	—	—	—	—	—	44·99	2·36	0·05	0·44
4	2·99	—	—	—	—	—	—	55·04	0·67	0·03	0·07
22	7·54	—	—	—	—	—	—	49·52	0·45	0·05	0·40
5	4·39	—	—	—	—	—	—	48·11	3·15	0·06	0·24
6	8·58	—	—	—	—	—	—	45·28	3·26	0·06	0·18
21	11·35	—	—	—	—	—	—	39·48	2·47	0·04	0·67
25	7·33	—	—	—	—	—	—	48·96	1·57	0·02	0·55
26	13·09	—	—	—	—	—	—	42·73	3·38	0·04	0·81
42	3·61	—	—	—	—	—	—	53·77	1·35	0·05	0·11
47	1·31	—	—	—	—	—	—	56·03	2·14	0·05	less than 0·01
56	3·27	—	—	—	—	—	—	49·52	0·22	0·03	0·64
59	2·18	—	—	—	—	—	—	50·51	2·47	0·05	less than 0·01
7	10·21	—	—	—	—	—	—	42·16	6·87	0·03	0·48
10	11·19	—	—	—	—	—	—	45·42	1·35	0·06	0·33
12	13·92	—	—	—	—	—	—	44·71	4·39	0·03	1·57
48	2·70	—	—	—	—	—	—	51·64	2·57	0·05	0·18
15	2·94	—	—	—	—	—	—	48·81	1·57	0·20	0·06
3	2·26	—	—	—	—	—	—	44·99	5·63	0·09	less than 0·01
24	6·92	—	—	—	—	—	—	43·30	4·05	0·05	0·44
2	11·67	—	—	—	—	—	—	45·42	2·93	0·06	0·64
23	5·14	—	—	—	—	—	—	40·75	8·67	0·06	0·34
37	4·38	—	—	—	—	—	—	46·41	4·16	0·05	0·39
44	9·22	—	—	—	—	—	—	34·52	11·82	0·06	0·56
43 & 58	1·48	—	—	—	—	—	—	56·17	0·67	0·06	0·18
62	0·49	—	—	—	—	—	—	51·50	0·90	0·04	less than 0·01
63	2·61	—	—	—	—	—	—	50·90	2·36	0·06	less than 0·01
67	3·30	—	—	—	—	—	—	55·20	0·90	0·02	0·17
From the above samples a composite sample, No. 73, was obtained, the analysis of which is as under :—											
73	6·04	73·64	1·17	4·66	0·11	1·00	3·77	47·40	3·26	0·05	0·40

TABLE OF ANALYSES OF SAMPLES—*continued.*

Sample No.	Insoluble Matter.	Manganese Di-oxide.	Manganous Oxide.	Ferric Oxide.	Phosphoric Anhydride.	Sulphur Tri-oxide.	Barium Oxide.	Total Manganese	Total Iron.	Phosphorus.	Sulphur.
	%	%	%	%	%	%	%	%	%	%	%
					M. S. 1143.						
29	1·38	—	—	—	—	—	—	52·99	2·94	0·06	0·05
31	1·11	—	—	—	—	—	—	49·95	5·98	0·06	0·01
33	1·28	—	—	—	—	—	—	49·68	7·82	0·05	less than 0·01
36	1·87	—	—	—	—	—	—	50·92	4·26	0·05	0·23
39	1·19	—	—	—	—	—	—	51·88	4·84	0·06	less than 0·01
54	3·11	—	—	—	—	—	—	50·23	5·68	0·04	0·19
60	2·29	—	—	—	—	—	—	37·26	14·62	0·05	0·63
From the above samples a composite sample, No. 75, was obtained, the analysis of which is as under :—											
75	1·48	77·04	1·22	9·14	0·11	0·42	0·58	49·62	6·40	0·05	0·17
					M. C. 11162.						
50	1·93	—	—	—	—	—	—	51·33	3·66	0·06	0·17
35	0·92	—	—	—	—	—	—	56·85	1·88	0·08	less than 0·01
13	0·90	—	—	—	—	—	—	52·71	3·42	0·07	less than 0·01
51	0·74	—	—	—	—	—	—	56·85	2·76	0·07	less than 0·01
53	2·62	—	—	—	—	—	—	55·47	1·76	0·08	less than 0·01
From the above samples a composite sample, No. 74, was obtained, the analysis of which is as under :—											
74	1·40	86·60	0·09	3·78	0·15	0·05	0·11	54·78	2·65	0·06	0·02
					M. C. 11155.						
64	4·29	79·34	1·10	2·41	0·43	0·17	0·68	50·94	1·69	0·19	0·07
					M. Sections 1138-1139.						
45	2·99	78·08	0·85	8·04	0·16	less than 0·02	0·70	49·95	5·63	0·07	less than 0·01
					M. S. 1139.						
57	3·43	78·30	1·03	6·11	0·16	0·10	0·90	50·23	4·28	0·07	0·04
					M. S. 1142.						
68	4·69	69·20	1·50	4·50	0·16	0·55	0·06	44·85	3·15	0·07	0·22

Estimation of Tonnage.

The workable deposits of manganese ore found at various places in the sheet of dolomite vary in size and in the content of manganese in the residual clay, and also in the quality of the ore, and these deposits lie for the most part beneath a cover of soil or lake silt. In some places the ore appears to be fairly uniformly distributed over an appreciable area, but in other places it is found in irregular pockets formed along the jointing planes, surrounded by undecomposed dolomite, and covered with a mantle of soil or silt, and although it may be stated generally that there is undoubtedly a very large tonnage of ore on the leases and claims of the company, it is very difficult to put this tonnage into figures.

A large number of the prospecting pits are too shallow to give any evidence as to the amount of ore present, and cannot be taken into account.

The manganese ore occurs in residual clay from the decomposition of the dolomite, and the proportion of ore to clay is different in different parts.

In the case of M.S. 1138, there is an area of about 16 chains by five chains, embracing the principal workings, containing a large number of exposures of ore.

The depth of ore bearing clay which can be seen in these pits and cuttings, ranges from 2ft. to 8½ft., and in many cases ore is still showing in the bottom of the openings, deeper sinking not having been carried out owing to the presence of water.

Taking the average thickness of the ore-bearing clay over this area as 4.8ft., and assuming that 40 per cent. of ore can be recovered from this clay, and that 8 cub. ft. of ore represents a ton of 2,000lbs., the tonnage shown for this block is 83,635 tons, which may be taken in round figures as 83,000 short tons of developed ore. The average value of all the samples taken on this mineral section, representing the ore as roughly sorted during mining, and excluding dressed ore samples, is as follows:—

Average of 18 samples—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
47.56	3.03	5.80	0.06	0.32

This assay representing the ore as roughly sorted, without any selection or beneficiation, shows it to come well within the recognised limits of ore desirable in the manufacture of manganese steel.

With regard to the other leases and claims, the information as to the thickness and continuity of the ore segregations is not definite and detailed enough to enable a calculation of developed ore to be made.

From an examination of the various workings, however, the following estimates have been made of the quantities of ore which it is reasonable to expect will be obtained from these workings and their extension.

M.S. 1139.—Ore reasonably supposed to exist at present workings, 653 tons of ore suitable for steel purposes.

M.S. 1136.—Ore reasonably supposed to exist at present workings, 13,231 tons; average value, as roughly sorted during mining, about:—

Manganese. Per cent.	Iron. Per cent.	Insoluble. Per cent.	Phosphorus. Per cent.	Sulphur. Per cent.
49.0	5.0	2	0.04	0.06

M.S. 1135.—Ore reasonably supposed to exist at present workings, 5,717 tons; average value as roughly sorted during mining:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
48.8	3.5	2.0	0.07	0.19

M.S. 1143.—Ore reasonably supposed to exist at present workings, 6,534 tons; average value as roughly sorted during mining:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
48.9	6.5	1.7	0.05	0.16

M.S. 1137.—Ore reasonably supposed to exist at present workings, 2,776 tons; average value as roughly sorted during mining:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
50.7	3.1	4.2	0.06	0.13

M.C. 11162.—Ore reasonably supposed to exist at present workings, 7,187 tons; average value as roughly sorted during mining:—

Manganese.	Iron.	Insoluble.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
53.17	2.94	1.81	0.07	0.04

This gives a total of reasonably probable ore for the present workings on these leases and claims of 36,098 short tons, or in round figures, 36,000 short tons.

From the examination of all the leases and claims it seems very probable that much more ore remains to be developed, and that the total tonnage will be very large.

For steel manufacture a considerable output of suitable ore can probably be obtained by simple sorting and selection during mining. For chemical purposes a very large amount can also be obtained, as much of the ore consists of high-grade nodules and lumps, only requiring to be cleaned from the adhering impurities.

Regarding the depth to which the ore may extend, this will depend on the thickness of the dolomite sheet from which the ore is derived. This lies uncomformably on a bedrock of reddish quartzite, which latter does not carry any manganese ore so far as seen. Owing to the unconformability, the thickness of dolomite varies, but at one place at Mount Gunson it is seen to have a thickness of 33ft. In many instances the ore appeared to be becoming more solid, and less intermixed with clay, as the excavation became deeper.

In some parts there is no overburden, but in most cases a certain amount of soil, averaging perhaps 2ft. in depth, overlies the ore, and must be removed, and in forming dumps for this material, care is needed that areas not containing ore should be selected.

The mining of the ore, being open cut and requiring little, if any, explosives, is cheap.

Manganese ores are extensively used for various industrial purposes. In the year 1910, close on 2 million tons; in 1911, over 1½ million tons; in 1912, over 1¾ million tons; in 1913, over 2¼ million tons, were obtained in the principal producing countries, of which Russia contributed about one-third, India a quarter, Brazil one-tenth, and Germany about one-sixteenth of the total.

Its use falls under two headings—metallurgical and chemical—of which the former consumes the greater portion of the total supply. In this regard it is used in the manufacture of steel and manganiferous iron, its

effect in the manufacture of steel being twofold, first acting as a de-oxidiser and de-sulphuriser, and, secondly, conferring special qualities of hardness and durability on the steel, by addition of the manganese itself.

In the manufacture of steel, the finished steel usually contains 12 per cent. to 14 per cent. of manganese, but as some of the latter is lost by volatilisation, in flue dust, and in the slag, the amount actually required is greater than this.

The manganese is alloyed with iron in varying amounts, either in blast or electric furnaces, alloys with less than 25 per cent. manganese being known as spiegeleisen, and over that percentage, as ferro-manganese, the usual proportion of manganese in the latter being about 80 per cent. The ferro-manganese is added to the liquid steel during manufacture in the proportion necessary to give the desired result.

For steel purposes manganese ore must be low in silica and phosphorus, and, in order to be able to produce 80 per cent. ferro-manganese, the iron content must not be too high.

The standard ore for steel purposes is usually taken as 8 per cent. silica and 0.25 per cent. phosphorus, and premiums and penalties are paid per unit or fraction of a unit variance from this standard.

Ore that is otherwise suitable, and contains as low as 45 per cent. metallic manganese, can be used, but 50 per cent. metallic manganese is generally specified. For metallurgical purposes another consideration may enter, and that is the physical characteristics of the ore. Where the ore is to be used in a blast furnace, fine and soft ore is objectionable, and a hard ore in fair-sized lumps is desired, in order to withstand the weight of the charge without crushing, and not to impede the blast, nor to cause undue loss of fine ore as flue dust.

However, the production of ferro-manganese in electric furnaces is now becoming more general, and for this style of smelting the materials are usually in more or less powdered form, and soft, fine ore would probably be the more suitable.

As a chemical agent, it is used in the manufacture of chlorine, dry cells, flint glass, for generating oxygen, for the manufacture of disinfectants, as a drier for paints and varnishes, in the manufacture of bromine, and as a dyeing agent.

It is also used as a coloring agent in paints, being known as umber when mixed with a certain amount of iron oxide, and also being used to give brown, green, and violet colors, and is used as a coloring agent in the manufacture of glass and pottery.

Its principal use in glass-making, however, is to discharge the green color due to the presence of iron, and the purple color seen in white glass exposed to sunlight for a considerable time is due to manganese.

For chemical purposes the ore is bought for its available oxygen content, not for its manganese content, and consequently the only suitable ore is the dioxide, which contains two molecules of oxygen, and by treatment can be made to give up one molecule of oxygen, the quantity thus given up being known as the available oxygen, and being the substance which is actually desired and paid for. As the closer the ore approaches to pure dioxide, the greater the quantity of oxygen available, only the highest grade ores are known as "chemical ores", and as manganese can be present in other mineral forms than the dioxide, the available oxygen does not necessarily depend on the total or metallic manganese content, but on the amount of manganese present as dioxide.

The Caucasian lump ore is stated to be exceptionally good for chemical purposes as, chemically, it is high in dioxide, and, therefore, in available oxygen, and low in iron, while physically it is sufficiently porous to allow acid to percolate through it, and at the same time hard enough not to fall to powder.

For dry cell manufacture, where the ore is used solely for its available oxygen, it is stated that it should contain at least 80 per cent. manganese dioxide, less than 1 per cent. of iron, and less than 0.05 per cent. of copper, nickel, or cobalt.

It is estimated that the present world demand for manganese ores for dry cells alone is 20,000 tons a year.

For use in the manufacture of flint glass there should be less than 1 per cent. of iron as the manganese is added to counteract the color due to the presence of iron in the glass. This it is supposed to effect in two ways, chemically by oxidising the green ferrous silicate to a slightly yellow ferric salt, and physically by yielding a violet manganic silicate complementary in color to the green ferrous silicate.

For the production of chlorine the presence of lime in the ore is objectionable, as it consumes acids needlessly, but for metallurgical purposes lime is not objectionable in itself, though of course it lowers the value of the ore by displacing manganese.

In blast furnace smelting for the production of ferro-manganese a basic slag must be made to avoid undue loss of manganese in the slag, and as lime is used to assist in forming such a slag, small quantities of lime in the ore are not deleterious. In blast furnace smelting for the production of ferro-manganese there is a loss of manganese as flue dust, as fume due to volatilization, and in the slag, amounting to about 25 per cent.

Barium, which is present in the ore in small quantity, is not objectionable in the production of ferro-manganese, as it acts as a base in the slag.

As a basic slag is required, the amount of silica present in the ore must be as low as possible, for silica, being an acid, requires the addition of basic material such as limestone to slag it off, and also by increasing the amount of slag increases the loss of manganese.

Treatment.—Up to the present most of the ore sold has been of chemical grade, and the method of treating the ore consists in hand-dressing, trimming off the adherent impurities, breaking the larger lumps by hand if necessary, and finally washing by stirring with a shovel in a small trough with running water. These methods are slow and expensive, and if the ore from these deposits is to compete successfully with the well-known producers of the supplies of the world, the cheapest and most effective mechanical treatment is required. A considerable portion of the ore appears to exist as nodules of high grade in the clay, the bulk of the impurities not being intimately mixed with the ore, but being extrinsic and capable of being removed by simple means.

In other cases some of the ore appears to be more or less cellular or cavernous, the openings containing loose pulverulent iron oxide, and by breaking to a suitable gauge, followed by a simple washing or agitation a large amount of the loosely adhering iron could be removed.

Again, a large amount of high-grade ore occurs in fine aggregations, too fine and too soft to be satisfactorily treated by hand.

As the gangue is mostly clay a mechanical means of treatment and concentrating this fine ore should be easily found.

Log washers, jigs, and concentrating tables would probably prove satisfactory, and the lake bed affords an ample supply of dressing water.

The following table, taken from the Statistical Report of the National Federation of Iron and Steel Manufacturers, 1918, shows the world's production of manganese:—

WORLD'S PRODUCTION OF MANGANESE ORE.

	1913.	1914.	1915.	1916.	1917.	1918.
	Tons	Tons	Tons	Tons	Tons	Tons
United Kingdom	5,393	3,437	4,840	5,140	9,942	17,456
Canada	—	28	47	979	158	—
Australia	—	—	963	2,692	—	—
India	815,047	682,898	450,416	645,204	590,813	—
Austria-Hungary	40,246	29,341	22,131	22,674	48,851	—
Italy	1,622	1,619	12,577	18,147	24,532	—
Japan	2,276	16,807	25,463	49,316	—	—
Brazil	180,738	183,330	288,671	503,130	427,267	—
Greece	—	—	408	3,600	—	—
Russia	970,000	652,355	*9,750	284,000	—	—
Spain	21,594	13,155	14,328	14,178	57,474	—
Sweden	4,001	3,643	7,607	8,894	19,873	—
Tunis	—	—	1,477	2,059	5,900	—
United States	4,048	2,635	9,709	31,474	129,405	294,000
Cuba	—	—	55,158	20,329	34,741	67,780

* Exports.

The following particulars are taken from The Mineral Resources of Georgia and Caucasia, by D. Ghambashidze, F.R.G.S., published in 1919.

Indian ore, which is stated to consist mostly of psilomelane and braunite, and therefore is generally of higher metallic manganese content than the pyrolusite ores, generally commands the highest price for steel purposes.

In the normal times before the war, in 1913, Indian ore was quoted 11d. to 11½d.; Georgian (Caucasian) ore, 9d. to 9½d.; and Brazilian, 6½d. to 7d. per unit of metallic manganese.

A typical assay of Indian ore is stated to be:—

	Per Cent.			Per Cent
Manganese dioxide	66·35		Manganese	51·05
Manganous oxide	11·78		Iron	2·08
Ferric oxide	2·92	Equivalent to	Phosphorus	0·16
Silica	8·10		Silica	8·10
Phosphoric Acid	0·37			

A list of typical analyses of cargoes of Caucasian ore from 1910 to 1913 shows the metallic manganese contents to range from 48.8 per cent. to 51.5 per cent., and the silica to range from 6.8 per cent. to 10.5 per cent., the iron content not being given. Brazilian ore is stated to be largely pyrolusite, averaging 48 per cent. to 52 per cent. metallic manganese, 3 per cent. metallic iron, 1 per cent. silica, and very little phosphorus, as low as 0.03 per cent., but its disadvantage is stated to be its great hardness.

In 1914 Brazilian ore from the district of Queluz, said to have an ore reserve of 10,000,000 tons, was landed at a total cost of about 28s. 6d. per ton c.i.f. United States of America, of which mining costs were 2s. 6d. per ton; railway freight to Rio and export duty, 6s. per ton; and sea freight, Rio to United States of America, 20s. per ton.

In India the cost of mining is stated to range from 2s. 9d. to 5s. 6d. per ton, and the railway freight from the deposits to Bombay (500 miles) is 9s. 6d. per ton, and to Calcutta (700 miles) is 13s. per ton. In normal times the sea freight from India to Europe and the United States of America varies between 16s. and 18s. per ton.

The average cost of extraction and dressing of ore at Tchiaturi (Caucasus) is given as 4s. per ton.

Salt.—The water of the lagoon is very saline. A sample of the water was taken from a shallow shaft sunk in the dolomite on M.S. 1137.

A considerable quantity of water had been pumped from this shaft previous to the sample having been taken, precluding the possibility of any undue concentration by evaporation.

The sample was analysed by Mr. W. S. Chapman, and the analysis is as under:—

	Grains per gallon.
Chlorine, Cl	6,835·69
Sulphuric acid (radicle) SO_4	365·75
Carbonic acid (radicle) CO_3	2·85
Sodium and Potassium (Na and K)	3,903·70
Calcium, Ca	78·85
Magnesium, Mg	318·78
Silica, SiO_2	0·80
Ferric oxide (Fe_2O_3) and alumina (Al_2O_3)	0·80
Total Saline matter ..... grains per gallon	11,507·22
Total Saline matter ..... oz. per gallon	26·3
Assumed composition of salts—	Grains per gallon.
Calcium carbonate	4·75
Calcium sulphate	261·63
Magnesium sulphate	226·34
Magnesium chloride	1,083·10
Sodium chloride	9,929·80
Potassium chloride	—
Silica	0·80
Ferric oxide and alumina	0·80

There are thus 22.6ozs. of sodium and potassium chlorides in the water out of a total saline content of 26.3ozs. per gallon.

The average salinity of sea water is about 3.5 per cent. (total salts), equivalent to 2,450 grains to the gallon, or 5.6 ozs. to the gallon.

The total salinity of the lake water is thus nearly 4.7 times as great as that of average sea water.

A system of concentrating and evaporating pans of brick and concrete has been built, in which it is proposed to concentrate and evaporate the lake water to obtain the salt, by means of solar heat.

The water is to be pumped from a shaft or shafts sunk in the dolomite. The quantity of saline water to be obtained is practically inexhaustible, and the climatic conditions are very favorable. Windmills, with an oil engine in reserve, should be very suitable for pumping as there is a large percentage of windy days throughout the year.

The annual evaporation is close on 70in., and the net annual evaporation, taking rainfall into account, is close on 60in.

A sample of total salt obtained by evaporating a small quantity of the lake water was assayed by Mr. W. S. Chapman, with the following results:—

	Per cent.
Water	9·93
Insoluble matter	0·05
Calcium sulphate	2·20
Magnesium sulphate	1·15
Magnesium chloride	3·24
Potassium chloride	0·26
Sodium chloride	83·14
	99·97

Fluor Spar.—Specimens of fluor spar, clear white crystalline fragments, were found scattered on the surface of the dolomite in several places on the eastern and southern shores of the arm of the lake on which the manganese claims and leases are situated, but no body or deposit of fluor spar was seen.

If any quantity of fluor spar could be obtained it would be of economic importance, and it would be worth while to endeavor to trace the origin of the scattered crystals.

Fluor spar, acid grade, f.o.b. mines, is quoted for September, 1919, in America at 30 dollars to 35 dollars per ton for lump, and 35 dollars to 45 dollars per ton for ground.

Fluor spar is mainly used as a flux in metallurgical operations, large quantities being used in the manufacture of basic open hearth steel, for which purpose 85 per cent. or over of calcium fluoride, and 3 per cent. or less of silica is specified.

Fluor spar is also used in enamelling iron and steel ware, in the manufacture of opal glass, and as a source of fluorine in the manufacture of hydrofluoric acid, &c. For chemical purposes the higher grades, prices for which are quoted above, are used exclusively.

Barytes.—A deposit of good barytes is found here, the workings being on M.S. 1136 and 1137.

The occurrence is extensive, and the quality is good, the barytes occurring in crystals and massive blocks of good color, in clay, and associated with gypsum.

A considerable quantity of barytes has been obtained and sold, but the deposits are not being worked at present.

No other deposit was seen anywhere else about the lake, although the analyses of the manganese samples show its presence in small quantities in every sample where its presence was sought.

Ochre.—On M.S. 1135 a pit has been sunk to a depth of 6½ft. in a deposit of natural red ochre (Indian Red), which outcrops at the edge of the lagoon.

The deposit as shown in the pit is solid, and the ochre could be quarried in quantity with very little picking. Judging by the extent of the outcrop, a considerable quantity of ochre could be obtained here.

A strip sample, taken down the face over a depth of 6½ft., was analysed by Mr. W. S. Chapman, and is as follows:—

	Per cent.
Ferric oxide	67·28
Alumina	4·76
Manganese oxide	trace
Silica (free)	3·76
Silica (combined)	0·54
Water at 110°C.	6·81
Water above 110°C.	4·08
Chlorine, calculated to sodium chloride (salt)	8·63
	95·86

As will be noticed, there is a considerable amount of salt in this ochre, which would probably have to be eliminated before using to make paint.

South Extended Manganese Syndicate.

Three leases, M.L. 2309, 2310, and 2311, situated on the S.W. shore of the lagoon, are known as the South Extended Manganese Syndicate.

Some work has been done on M.L. 2310, close to the boundary of M.S. 1134, a number of pits and excavations having been made, from which a certain amount of ore was obtained.

A sample, representing the ore as roughly sorted during mining, was taken, the analysis being as follows:—

Sample No. 30—

Insoluble Matter.	Manganese Dioxide.	Manganous Oxide.	Ferric Oxide.	Phosphoric Anhydride.	Sulphur Trioxide.	Barium Oxide.	Total Manganese.	Total Iron.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent	Per cent.	Per cent.	Per cent.
3·36	82·24	0·73	3·53	0·18	0·16	0·09	52·49	2·47	0·08	0·06

No work was proceeding at time of visiting.

M.C. Nos. 11107, 11108, 11110, and 11111 are held by another owner, and adjoin the Australian Manganese Company's leases on the N.W. end.

Manganese ore was seen on them, but very little work has been done, and no work was in progress at the time of inspection.

McGregor's Workings.

These workings adjoin the property of the Australian Manganese Company. M.C. Nos. 10896, 11116, 11117, 11118, 11119, and 11163 are held, the principal workings being on M.C. 11116 and 10896.

The workings on the latter claim are known as the Hill Workings, being situated on rising ground above the lake level, and those on M.C. 11116, the only ones being worked at the time of visiting, are known as the Lake Workings.

On M.C. 10896 there are various pits and excavations, showing different amounts of manganese ore, 3ft. of ore and clay being exposed in one place.

The Lake Workings form a continuation of the workings of the Australian Manganese Company on M.C. 11162.

The main excavation is about 30ft. by 40ft., and is a little above the lake level, the ore lying under about 2ft. of blown sand. The ore deposit is the same as elsewhere, consisting of segregations in the residual clay, resulting from the decomposition of the dolomite.

The ore, which appears to be high-grade when separated from the clay, the chief impurity being a small percentage of iron, is of the soft blue pyrolusite variety.

The depth of the cuttings is 3ft. 4in., which is the present water level.

A sample taken over this depth, representing the ore as sorted during mining, is as follows:—

Insoluble Matter.	Manganese Dioxide.	Manganous Oxide.	Ferric Oxide.	Phosphoric Anhydride.	Sulphur Trioxide.	Barium Oxide.	Total Manganese.	Total Iron.	Phosphorus.	Sulphur.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
0·40	88·72	0·20	3·53	0·18	0·06	0·05	56·17	2·47	0·08	0·02

From the main cutting, towards the E. and S.E., a few small pits show manganiferous dolomite and manganese ore, but very little other work has been done.

The ore is prepared for sale by picking and dressing, and washing by hand, but a considerable amount of it appears too fine to be suited to such methods, and it appears probable that some form of mechanical treatment would be cheaper and more successful.

Though it appears probable that there is a considerable quantity of ore here, the work done is not sufficient to enable any estimate to be made.

On the rest of the claims little, if any, work has yet been done, except on M.C. 10982, where a little prospecting shows the presence of traces of manganese in gypseous clay.

There are a number of other claims held for manganese, adjoining the Australian Manganese claims and leases. These are shown on the plan attached to the report.

No detailed inspection was made of them, but manganiferous dolomite was observed on some of them, and also some shallow workings in places, which showed the presence of manganese ore.

Also, as previously mentioned, some good manganese ore was seen exposed in a pit, which had been sunk on a claim close to the Woocalla Railway Station.

It is quite possible that further workable deposits of manganese ore may be found anywhere in the extent of the manganese-bearing dolomite, and the color of the soil, and the presence of manganese shoad stones, would probably give an indication of the presence of manganese, where no actual outcrops were seen.

Summary.

To sum up briefly it may be stated that although from the nature of the deposits, and from the want of sufficient prospecting, it is not possible to estimate the total tonnage of ore, yet there is no doubt that a very large amount of ore is to be obtained from the various leases and claims of the Australian Manganese Company, and further prospecting will no doubt largely add to the known occurrences.

A large tonnage of ore suitable for steel manufacture can be obtained by sorting the masses of ore from the clay, with but little cleaning, and a large tonnage of chemical grade ore can be obtained by selection and cleaning of the ore. The beneficiation of the ore to obtain chemical ore can probably be done cheaply and efficiently by mechanical means, there being an ample supply of dressing water.

In this regard it is not of course meant that ore consisting of an intimate mixture of iron and manganese can be successfully treated by mechanical means; but that the grains and nodules of ore can be freed from adhering impurities consisting of clay, and in some cases, loose pulverulent limonite, or oxide of iron.

The mining is cheap, the amount of overburden being generally not more than 2ft., and often less, and little, if any, explosives are required.

The distance to the nearest railway station is at present about eight miles, which can be shortened to some extent by selection of a more direct route.

The present means of transport is by donkey teams, but if an outlet for the ore in sufficient quantities can be obtained, cheaper mechanical transport by tractors, aerial cable, or other means, could be adopted.

The want of a supply of water for domestic and stock purposes has been a disadvantage in the past, as no suitable supplies of underground water have been obtained, and reliance must be placed on surface dams for the storage of rainwater.

In this regard the company have two dams, each stated to have a capacity of 100,000galls., and a Government dam close to their property is stated to have a capacity of 400,000galls.

Firewood has to be carted from about six miles distant. The manganese claims and leases are situated on a pastoral lease, but a commonage reserve of a certain area around the mining leases has been declared, to serve the convenience of the mining industry.

With regard to the question of working the manganese deposits below water level, there should not be much difficulty in keeping the water down by means of pumping, as the residual clay in which the ore occurs does not allow the ready passage of the water, and will probably hold it back sufficiently to allow of any particular workings being kept dry without undue expense.

The following particulars regarding the sales of their manganese ore have been kindly supplied by the managing director of the Australian Manganese Company.

The total quantity shipped from January, 1917, to April, 1919, is 841 tons, of which 735 tons have been sold.

Of this total, the following analyses refer to two lots, one of 152 tons, and one of 164 tons. Analyses by Messrs. Edward Riley and Harbord, Finsbury Square, London.

	164 tons.	152 tons.
	Per cent.	Per cent.
Moisture	1·55	2·73
And on ore dried at 212° F.—		
Peroxide of manganese	86·64	85·83
Protoxide of manganese	1·49	1·61
Peroxide of iron	4·29	4·89
Silica	1·80	1·60
Alumina	1·18	1·48
Lime	0·40	0·30
Magnesia	0·18	0·19
Sulphuric anhydride	0·26	0·242
Phosphoric acid	0·078	0·089
Arsenic acid	nil	nil
Oxide of copper	0·02	trace
Carbon dioxide	trace	trace
Combined water	3·37	3·62
	99·708	99·851
Metallic manganese	55·93	55·51
Metallic iron	3·00	3·42
Sulphur	0·104	0·097
Phosphorus	0·034	0·039

The following analysis is stated to refer to a shipment of 102 tons:—

Analysis by Ledoux & Company (Inc.), Engineers, Chemists, and Assayers, New York.

After drying at 100° C.	Per Cent.
Manganese	—
Iron	3·44
Phosphorus	—
Silica	—
Copper	—
Available Oxygen	15·62
equivalent to	
Manganese Dioxide	84.87

The following schedule shows the leases and claims held at the Australian Manganese Company's property, and in the immediate vicinity, those held by Geo. P. Harris Scarfe, & Co., representing the holdings of the Australian Manganese Company:—

No. Mineral Claim.	Held by.	No. Mineral Lease.	No. Mineral Section.	Held by.
11162	Geo. P. Harris, Scarfe & Co.	2305	1143	Geo. P. Harris, Scarfe & Co.
11155	"	2304	1142	"
11116	A. E. McGregor	2303	1141	"
11117	"	2302	1140	"
11118	"	2301	1139	"
11119	"	2284	1138	"
11163	"	2285	1137	"
10896	"	2283	1136	"
11110	M. Griffiths	2282	1135	"
11111	"	2300	1134	"
11107	"	2309	—	J. H. Flannagan
11108	"	2310	—	B. B. McGillick
10981	Not held	2311	—	Jas. O'Neill.
10982	Not held	—	—	—

—(8-1-20.)

REPORTS

BY

The Inspector of Mines (H. Jones).

COMMON OPAL NEAR CLEVE.

A find has been made near the Poornamookannie Creek, about two miles northward from the town ship of Cleve, of the ordinary variety of common opal, which is very widely distributed in South Australia.

No sign of the precious opal can be seen in the specimens, and, although it is always possible that the gem variety may be found in a place where common opal occurs, yet the fact remains, the productive localities have hitherto been restricted to certain sandstones in the interior of Australia. —(20-8-19.)

HOMEWARD BOUND GOLD MINE.

(*Vide* Record, p. 246, and Reviews Nos. 9, 11, 14, 15, 18-25, and 28.)

Jones's workings, situated near the western boundary, No. 1 shaft has been sunk from the outcrop on the southern dip of the lode, to a depth of 50ft. Stoping has been done east and west of it, and several parcels of ore gave good returns on treatment at the Peterborough plant. Work at present is confined to No. 2 shaft, 20ft. further west, down 14ft. vertical, and 30ft. on the dip of the lode; the greater portion of the lode material between the shafts has been stoped out, and the work of deepening the shaft and stoping ore on the western side is in progress. The formation exposed in the workings consists of siliceous calcite, associated with iron-stone 9in. to 12in. in width, containing gold and bismuth. The vein is well defined, and seems likely to persist.

Jenkins's workings, situated a short distance east of these, consist of two underlie shafts sunk in the lode. In No. 1, a fair amount of work has been done down to the 80ft. level; from the different stopes 30 tons of ore gave a return of 3ozs. of gold bullion per ton, and the shoot of gold-bearing stone seems to be extending westward. Operations in this shaft are suspended pending the sinking of a larger shaft in the vicinity, to give better facilities for hauling, and to improve ventilation.

About 40ft. eastward from this shaft, a new shaft has been started in the lode, now down 50ft. The intention is to sink to the 80ft. level, and connect with the other workings. The vein at the present bottom is from 6in. to 9in. wide.

The lode traversing this property has been tested by shallow pits along the outcrop for a considerable distance, and the returns from the large number of parcels treated, demonstrate that the lode contains fairly rich ore in places.

To further work and develop the mine to the best advantage, it is strongly recommended that larger sized shafts be carried down in the lode, with connections at intervals for ventilation. This would enable stoping to be done east and west to a much greater extent, and also afford facilities for carrying down exploration work in the ore channel at depth.—(11-10-19.)

KLONDYKE.

(*Vide* Record, page 246, and Review No. 9.)

The work at present in progress is the sinking of a vertical shaft near the eastern boundary of the block, not far from Jones's workings, on the Homeward Bound lease. This is now down to 25ft., and in the bottom the vein shows a width of from 9in. to 15in. of siliceous and ferruginous calcite, carrying a little gold. A drive is being extended to the eastward in order to intersect the shoot of good ore proved in Jones's shaft, which is probably coming westward into this property.—(18-10-19.)

BUMBUMBIE, NEAR TEETULPA.

(*Vide* Record, page 316.)

Some prospecting has been done recently in the old workings, but without satisfactory results. Samples taken from two small heaps of ore found on the surface gave on assay the following results:—

No. 1.—North dump, 15dwts. gold per ton, and traces of silver and bismuth.

No. 2.—South dump, 3dwts. gold per ton, and trace of silver.—(30-9-19.)

LANGFORD'S CLAIMS, LOVELY GULLY, NEAR WAUKARINGA.

(*Vide* Record, page 211, and Reviews Nos. 17, 19, and 20.)

The present workings are situated about four chains eastward from the old Laura Gold Mine, and consist of two shafts sunk in an argillaceous formation containing irregular seams and bunches of green and blue carbonates and grey copper ore. No. 1 shaft is 25ft. vertical and 15ft. on the underlie. At the 25ft. level a drive has been extended N. 10° E. for 40ft.; the argillaceous body in the drive is 5ft. wide, containing two seams of copper ore 3in. to 4in. wide. A sample taken from the footwall seam gave 3.5 per cent. copper, and a trace of gold and bismuth. From the hanging wall vein 2.9 per cent. copper and trace of gold; from lode matrix on surface, 5.4 per cent. copper and trace of gold.

No. 2 shaft, a short distance north, is now down 32ft.—(21-10-19.)

HICKS AND HOOPER'S COPPER MINE.

(*Vide* Reviews Nos. 9, 10, 13, 16, 24, 28, and 29.)

Situated on portion of the Yelta Mine, near Moonta, the main underlie shaft is now down 46 fathoms, 25ft. of which was sunk for water storage, which is convenient, and a great saving, as the plant can now be utilised either for pumping or hauling. At the 15 fathom level the N.E. drive is now in a total distance of 560ft., and at this point a connection is being made with the new underlie shaft.

At 25-fathom level, the N.E. drive is in a total distance of 300ft., and from No. 1 winze to No. 2 winze a distance of about 80ft., the ore body is well defined, showing an average width of 24in. of high-grade sulphide ore. In the face of the drive, the ore body was cut off by a small fault crossing the drive. Near the fault a crosscut has been extended into the

footwall, and at 3ft. a defined branch of ore was intersected, 9in. wide, which proved to extend in the N.E. drive for 20ft., and in the S.W. drive for 30ft., but it pinched out at both ends.

At 6ft. up in No. 2 winze, and 10ft. N.E. from the winze, stoping is in progress on an ore body, from 18in. to 24in. wide, of clean yellow and purple ore of fairly high grade.

From the 42-fathom level, the N.E. drive is in a total distance of 250ft., where it connects with the winze sunk from No. 2 level; a strong and well-defined body of sulphide ore is exposed for the last 60ft., and good ore, 24in. wide, is now showing in the face. About 65 tons of ore from the different levels were recently forwarded to the smelting works, and a further parcel of about 60 tons is now being dressed on the surface.

All the underground workings and the ventilation of the mine are in satisfactory condition, and the lode exposed in the various workings seems likely to yield a large quantity of high-grade ore.—(3-12-19.)

WALLIS AND PARTY—COPPER MINE.

[Adjoining and N.E. of the Moonta Leases—Block No. 2.]

The main underlie shaft, 6ft. x 4ft. in the clear, has now reached a depth of 114ft., and further sinking is in progress. The ferruginous ore channel is from 18in. to 24in. wide, and at present contains no copper ore. At the 15-fathom level a drive in the ore channel has been made S.W. for 12 fathoms, but so far no ore has been found. At the same level, a drive has been extended N.E. for 15 fathoms, and at a point 30ft. from the shaft, a shoot of copper ore, 3in. to 9in. wide, is exposed for a length of 28ft. along the drive. Underhand stoping has been done in this shoot to a depth of 18ft., for a length of 25ft., with good ore still showing in the bottom. Over the back of the drive, in the same run of ore, stoping has been carried up for 17ft., the vein of ore being from 3in. to 6in. wide, and will be extended to the surface for ventilation. About 30 tons of ore have been forwarded to the Wallaroo Smelters.

Instructions have been given as to ventilation, and the proper securing of the ventilation pipes.—(10-12-19.)

CORNWALL COPPER MINE.

(*Vide* Record, page 46, and Reviews Nos. 15, 16, and 25.)

The only work in progress here is picking over the old dump, and some small parcels of ore so obtained have been forwarded to the Smelters.

Similar fossicking over old dumps is in progress at the Wandilta Mine. —(30-12-19.)

Reports on the Following Quarries.—Lines's Quarry (Tarcowie), Jamestown D.C., Jamestown Corporation (3), Yacka, Calver's (Tapley's Hill), Edwards's (Tapley's Hill), Reynella (2), Pocock's (2) (Noarlunga), Pink Freestone Quarry (Noarlunga), Sheoak, Crafer's Summit, Sims's (Glen Osmond), Binks's (Crafers). In all cases, where necessary, instructions have been given to insure the safety of the workings.

REPORT

BY

The Chief Registrar of Mines (L. C. E. Gee, S.M.)

NOTES ON THE WELFARE AND BETTERMENT WORK BY THE BROKEN HILL PROPRIETARY COMPANY, LIMITED, AT IRON KNOB AND HUMMOCK HILL.

The large deposit of iron ore, known generally as The Iron Knob, worked by the Broken Hill Proprietary Company, Limited, is situated in the northern portion of Eyre Peninsula, about 41 miles west-south-west of Port Augusta. A railway line, constructed by the company, 33½ miles in length, running in a south-easterly direction, connects the iron ore deposits with Hummock Hill (Whyalla), the port of shipment. The distance across Spencer Gulf to Port Pirie is about 25 miles. Shipments are made to the Broken Hill Associated Smelters at Port Pirie, but the bulk of the ore is forwarded to the Company's iron works at Newcastle, New South Wales.

The district may be classed as pastoral myall and saltbush country, with a limited rainfall, the mean annual average being about 8½in., and were it not for the operations connected with the exploitation of the iron ore, the settlements at Iron Knob and Hummock Hill would have no existence, and the permanent population of this extensive track would probably merely consist of a few boundary riders. It was therefore necessary, apart from any other considerations, that in order to carry out its operations in this rather inhospitable country, the company was obliged to make certain provisions for the material needs of its employees in the shape of water, food, and lodging. This has been done in the past, and it seems, on the whole, wisely and well, and considerable extensions in all directions are now in hand.

At The Iron Knob.

The number of hands employed here under normal conditions is 220, but at present only 170 men are engaged. A general store has been established, goods of all description being sold at the current rates ruling at Port Pirie. The company's bakery supplies the townspeople as well as the employees. At the mess house good and abundant meals are provided, and men are lodged in houses and tents, the charges made being 19s. per week board, 1s. per week lodging, and 6d. per week medical, and this latter payment covers all medical attendance for self and family (with the exceptions of maternity cases) and also all medicine.

Thirty-two galvanized-iron cottages have been built, the rent ranging from 3s. 6d. to 6s. 6d. per week, and there are also in occupation by single men five blocks of barracks, galvanized iron, lined with matchboard, seven rooms 10ft. x 12ft. x 10ft. in each block, and bathrooms attached, two men to each room. Two blocks of batchelor's quarters, barracks, have been built

Single Men's Quarters, Iron Knob.

Married Men's Houses—Iron Knob and Hummock Hill—
Galvanized Iron (an intermediate stage).

Face p. 98.]

of reinforced concrete, with tile roofs. Each block consists of seven rooms, 12ft. x 12ft. x 12ft., two men to a room. Bathrooms and laundry are attached, with every convenience. It is proposed to erect 14 more blocks, with bathrooms, &c., as above to each two blocks. Two men are engaged by the company to keep these places in good and proper order. For married employees very comfortable reinforced concrete cottages are being built, and six of them are now nearly completed. They are each of five good rooms, with bathroom and washhouse, verandah back and front, water is laid on, and the rent will be about 12s. per week.

It is the intention of the company eventually to build a large mess room and kitchen of reinforced concrete, and also a large and up-to-date recreation hall, with reading and billiard rooms attached.

A Red Cross station is established at each of the quarries, with all necessary appliances in case of accident.

On certain holidays the company runs a special free train to the beach for the benefit of the employees and their families.

Hummock Hill.

The number of hands employed here would be under normal conditions about 350; at present 315 men are engaged.

An institute exists here, in a small building, and owing to picture shows, etc., has been a financial success. A large and handsome institute and recreation hall is now in the course of construction, to cost about £4,300, and of this amount the company contributes £3,300 as a free gift, and the Institute Committee will furnish the balance.

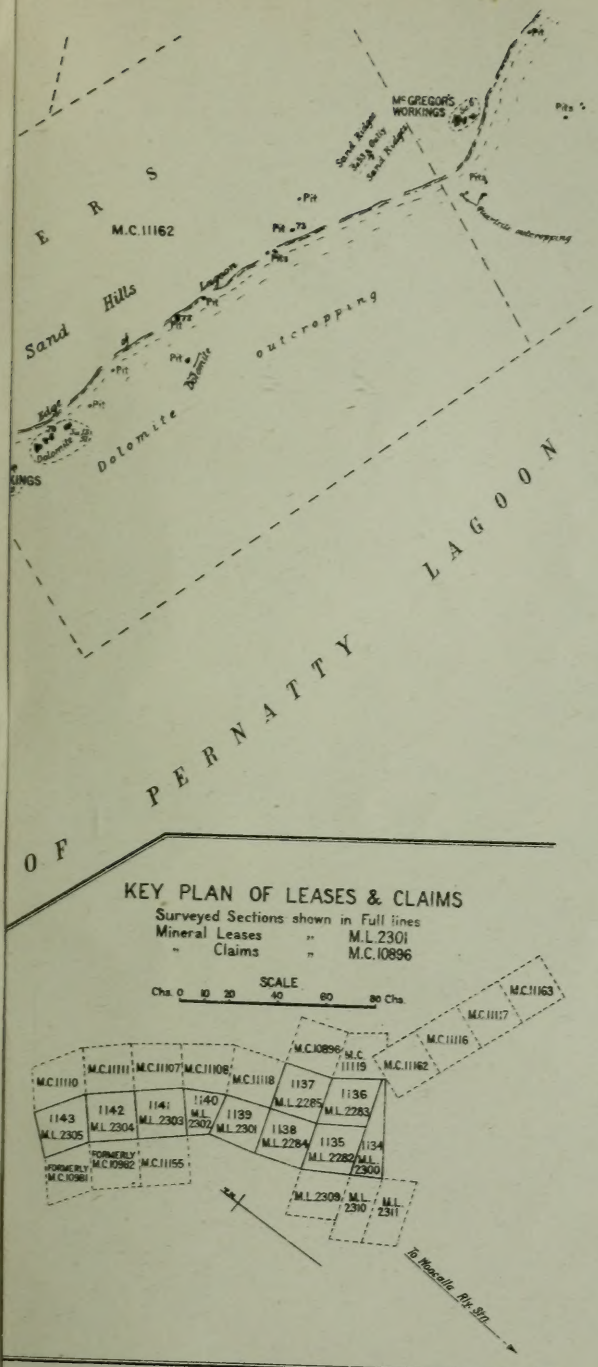
A fine and well-designed church is also in the course of erection by the company; it will be available for all denominations, but will remain the property of the company.

A mess room is provided for single men and tent lodging; they pay on the same scale as at Iron Knob, viz., 19s. per week board, 1s. lodging, and 6d. per week to the medical fund. Men are assisted to build their own houses, material being supplied, the cost of which can be paid off in instalments.

The company has erected 48 houses, with rents ranging from 4s. 6d. to 12s. 6d. per week, with water and electric light laid on.

The new cottages, of which a considerable number are now being erected by the company, are excellent, comfortable, and quite up-to-date; they are constructed of reinforced concrete, tile roof, verandah back and front, five good rooms, broad passage, bathroom, washhouse and stove, water and electric light supplied; the rent of these will be 12s. 6d. per week, and include everything.

PLAN.



KEY PLAN OF LEASES & CLAIMS

Surveyed Sections shown in Full lines
Mineral Leases " M.L.2301
" Claims " M.C.10896

SCALE
Chs. 0 10 20 40 60 80 Chs.

M.L.2311

PLAN

SHOWING

Manganese, Salt, & Barytes Workings

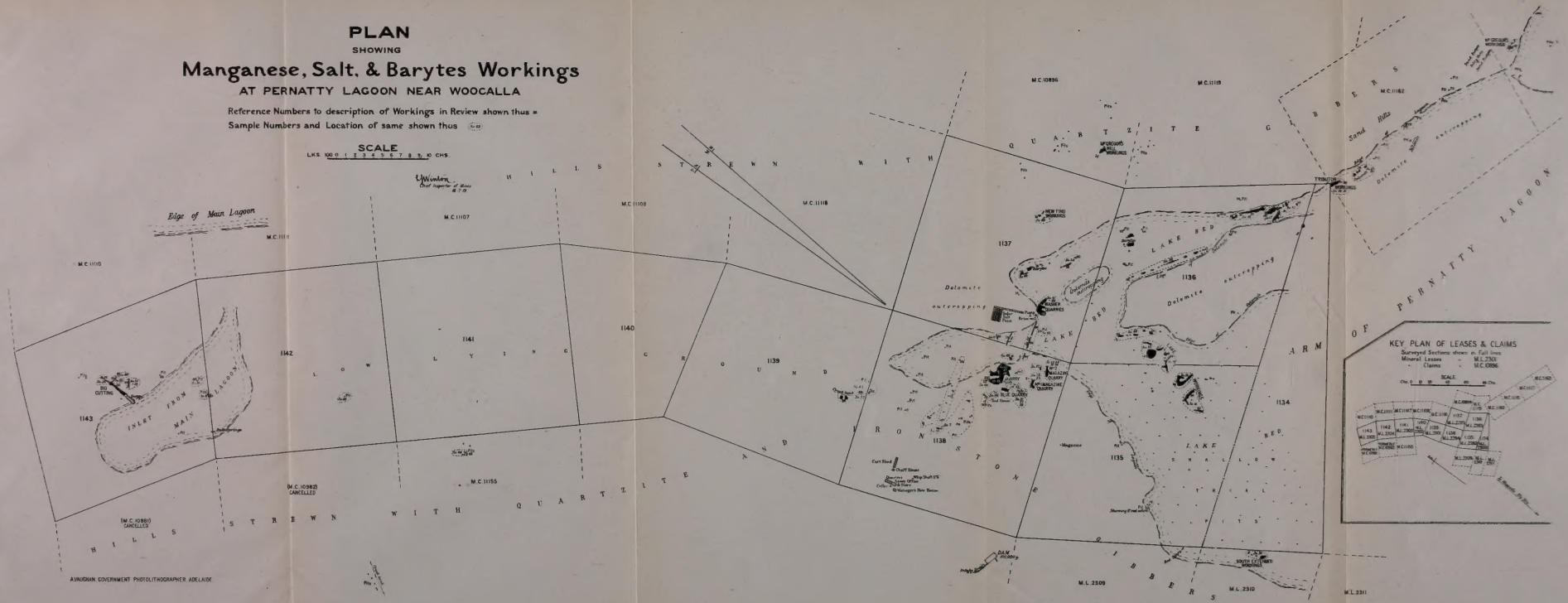
AT PERNATTY LAGOON NEAR WOOCALLA

Reference Numbers to description of Workings in Review shown thus =

Sample Numbers and Location of same shown thus

SCALE

LKS 100 0 1 2 3 4 5 6 7 8 9 10 CHS



AVIAN GOVERNMENT PHOTOLITHOGRAPHER ADELAIDE